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The Dynamics of the Schoolchild's Mental Development in Relation to Teaching and Learning

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In today's presentation,[1] I would like to focus on some problems that have been elaborated by pedology in the recent years—the problems of mental development of the child in the process of his education. These are questions of how mental development is related to the child's progress in his school studies.

In the past, these questions were answered in a rather straightforward way, in the same manner as a naive person would respond after discovering an empirically established connection between the mental development of the child and the possibility of educating him. It is well known that education should be attuned to certain stages that the child passes in his mental development. One should not start teaching arithmetic to either a 3- or a 12-year-old child. The best age for teaching arithmetic is approximately between ages 6 and 8 years. An enormous pedagogical experience as well as simple empirical observations, and some older research studies testify that mental development and the process of education are closely connected and should be coordinated.

This connection, however, has been conceived of in a rather simplistic way. If we take stock of studies conducted in the last 10 years in different countries, then it would not be exaggerating to state that there has been a radical change in researchers' views on the relationships between the child's mental development and education.

How do the classics such as Meumann (1914) and Binet (1909) imagine these relationships? They considered development to be the necessary prerequisite of learning. If mental functions (intellectual operations) are not sufficiently mature for a child to start studying this or that subject, then such study is fruitless. Thus, they thought that development should be a precursor of teaching and learning. Education should be based on development and it should use those functions that have already matured, because only under these conditions does education become possible and fruitful. They were afraid, mainly, of starting education prematurely and of teaching the child some subject at a time when he was not yet mature. All researchers' efforts were aimed at identifying the lower threshold of educability (i.e., the earliest age at which the teaching and learning process is possible).

How did they search for such an age? That was done and is still done mainly via tests and problems whose solution require the child to use certain mental operations. If the child solved such problems independently, it was decided that the abilities required for the solution

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were mature enough and that, consequently, the process of education could be started. If these abilities had not matured, then the child was not yet ready for schooling.

It would not be exaggerating to state that the diagnosis of the child's mental development in relation to schooling was conducted in the same way as intelligence testing is conducted for the purpose of professional selection. When the goal is to find a suitable candidate for a certain profession, reasoning is as follows: To become a good professional in a certain area, the candidate must possess certain qualities. Then if the subject has demonstrated the required qualities, he is declared suitable, and if these qualities are absent or insufficiently developed, it is concluded that the candidate is not suitable for the given profession. Children were selected for schooling in the same way. If the child already possessed mature functions required for the profession of schoolchild, he was declared suitable for schooling.

This point of view started to waver when (the following) extremely important rule was established. This rule, however, is used so rarely in both theory and practice that it is not even mentioned in the textbooks. Everyone is aware of the simple truth that it is impossible to teach some subjects prematurely. However, not that many even among those who study pedology have heard that it is also impossible to teach when it is too late and that for any given teaching and learning, there is always an optimal period. The deviation from this optimal period in either direction can be lethal. This is similar to the optimal temperature of the human body, which is 37 °C, the deviation from which can be dangerous for life functions and may result in death. Exactly in the same way, the study of each school subject has its own "optimal temperature"; if we start too early or too late, teaching and learning will become complicated.

Let us take a simple example. A child starts learning to talk at the age of 1.5 years, or even earlier. It is obvious that to start learning to talk, the child must have some already matured functions. However, if the child is mentally retarded, he starts talking later because these functions mature later. It would appear that if we start teaching the child to talk at the age of 3 years, these functions will be more mature than at the age of 1.5 years. It turns out, however, that the child learns to talk at the age of 3 years with greater difficulty and not as well as at the age of 1.5 years. This violates the main law on which Binet (1909), Meumann (1914), and other representatives of classical psychology based their work, the law of maturity of functions that proclaimed that the maturation of certain functions is the necessary precursor of teaching and learning.

If that law were correct, then the later we start educating the child, the easier the process of learning. For example, to learn speech, one needs certain prerequisites of attention, memory, and intelligence. Some of these prerequisites are more mature at the age of 3 years than at the age of 1.5 years. Why then is it more difficult to teach the child to talk at the age of 3 years than at 1.5 years? Some recent studies, although rather tendentious because they belong to a specific pedagogical trend, have demonstrated that study of written language is easier at the age of 5–6 years than 8–9 years. It is clear that written language presupposes a certain maturity of [mental] functions. At the age of 8–9 years, these functions are more mature than at the age of 5–6 years. If it were correct that learning requires the maturity of these functions, then it is not clear why study at a later age becomes more complicated.

Moreover, the comparison of the learning and developmental processes at earlier and later age periods has revealed that learning takes different routes at different ages. If one compares the study of a foreign language at school and the acquisition of the mother tongue at the age of 1.5 years, it might appear that study at the age of 8 years should be faster because all the prerequisite functions are more developed at the age of 8 years. However, although

the functions of memory, attention, and intelligence are more developed at the age of 8 years, the study of a foreign language at this age is much more complicated and the results are much less impressive than language learning at the age of 1.5 years when a child is capable of learning one, two, or even three languages without any mutual inhibition. Research has demonstrated that it is not only more difficult to teach a foreign language to a child at the age of 8 than 1.5 years, but also that at an older age, children learn languages in a different way based on different psychological functions. Thus, the idea of an optimal educational age has challenged the notion of the maturity of functions as a necessary prerequisite of schooling.

Further research has demonstrated that the relationships between the mental development of the child and his learning are much more complicated than previously imagined. I would like now to focus on certain studies related to this problem and show their connection to the mental development of children in regular and special education schools. I will point to the dynamics of mental development of children in school. All children entering schools can be divided (roughly) into four groups according to their mental development. There are some children whose mental development lags so seriously behind that they cannot study in a regular school and are sent to special institutions. We will put this group aside. The remaining children who enter school can be divided into those with a high, average, or low level of mental development.

Usually, this [level] is defined with the help of the coefficient of mental development—the IQ. The IQ is the relation of the mental age of the child to his chronological age; thus, if a child is 8 years old and his mental development corresponds to the mental age of an 8-year-old, then his coefficient is 1 or 100%. If an 8-year-old child has the mental development of a 12-year-old, his coefficient is 1.5 or 150%. If, on the contrary, the 8-year-old child has the mental development of a 6-year-old, then his coefficient is 0.75 or 75%.

Let us agree to divide all children entering school into three levels. The first level includes children whose IQ is higher than 110%. These are children whose mental age is ahead of their chronological age by at least 10%. The second level includes children with an IQ between 90% and 110%. These are average children with a slight deviation of their IQ around 100%. The third level includes children with an IQ of less than 90% but not lower than 70%.

Which of these children will study better at school and which will not? The whole reason for evaluating the level of a child's mental development before he enters school is based on the assumption that there is a relationship between the level of mental development and school achievement. This assumption is based both on simple observations and on statistical–theoretical studies that demonstrated a strong relationship between the child's school achievement and his IQ. At the [time] of school entry, every educator assumes that children of the first level will be most successful, children of the second level in the second place, and children of the third level in the third place. This is the rule used in schools all over the world, and this is the basic wisdom of pedagogical evaluations conducted at the [time] of school entry.

The same thing takes place in special education schools. When children come to such a school, they are ranked and, then, it is claimed that children who are less retarded will study better, those in the middle will show medium achievement, and the more retarded will be in the third place. When [we] started investigating whether such a prediction is justified and, as always in science, refused to simply accept observations and common sense, but instead conducted a verification, it turned out that the prediction is not justified. Several researchers, such as Terman (1916) in the United States, Burt (1930) in England, and Blonsky (1925) here

TABLE 1. IQ Level, IQ Dynamics, and School Achievement

		School Achievement	
IQ Level	Dynamics of IQ	Absolute	Relative
High	3	1	2
Medium	2	2	3
Low	1	3	1

(in Moscow) demonstrated that when the dynamics of IQ during school study is checked in children with higher and lower initial IQ, it turns out that most children who come to school with a high IQ have a tendency to lower it.

What does this mean? It means that although in absolute terms these children may still be ahead of others, in reference to themselves, they lose their [initially] high IQ during school study. Contrarily, children with [initially] lower IQ have a tendency to improve it, again relative to themselves, because in absolute terms, they may still be behind the first group. Children with an average IQ tend to maintain it (see Table 1).

Thus, in terms of IQ dynamics, those indicated by 1 will be in the first place, those by 2 in the second, and those by 3 in the third place. The order is thus reversed. In his studies, Terman (1916) demonstrated that the dynamics of mental development in school contradicts our expectations based on common sense and old psychological theory. We expected that the children who came with high IQ would develop the best during school study. It turned out that their development was the weakest because school impact unfavorably on their mental development by slowing its pace. The highest gain in school is made by children with a low IQ, whereas the pace of children with a medium IQ remains the same.

This paradoxical discovery prompted several studies that attempted to explain how a child who comes to school with the highest level of mental development, in the course of schooling, becomes the lowest in terms of the dynamics of IQ. This paradox becomes even more complicated if we compare it with [children's] school achievement. How will these three groups of children be distributed in terms of school achievement? We know that there is a strong correlation between IQ and school achievement. Which group will be the best in terms of school study? It turns out that the best will again be those with [initially] highest IQ, the medium IQ group will be in the middle, and the low IQ group will be the third. This means that the order of these groups again becomes the same as at the time of school entry. One may be the first in IQ at the time of school entry and then the last in terms of the dynamics of IQ and then again the first in school achievement.

These empirically established relationships on the one hand have led to considerable difficulties and puzzlement, but on the other hand have demonstrated that the relationships between the process of school teaching and learning and the IQ of the child are much more complicated than previously thought.

It became possible to solve this problem when the fourth parameter was investigated and it allowed us to explain the aforementioned contradictions, at least to a certain extent. What I am referring to is a study of so-called *relative achievement* that has great practical importance for schooling. Allow me to clarify. Let us imagine that one of us, adults, is placed in second or fourth grade in primary school. I think that such a person would certainly become the most successful student in this grade in absolute terms, that is, the school requirements would be

fulfilled by such an adult better than by any other student. But if we ask whether this person would learn something new, the answer is that he would leave with the same knowledge as at the beginning. Clearly, in terms of relative achievement, such a person would be the last because in a year of study, he would gain nothing. We can state with confidence that the least successful of the underachieving children would be ahead of such an adult in terms of relative achievement. Thus, we can see that absolute achievement does not tell us anything about relative achievement.

For example, from a study of reading fluency, we know that children enter school with different fluency in reading: for some, this is 20 words per minute; for others, it is just five words. The first group in a year will read with a speed of 30 words per minute, and the second—15 words per minute. In terms of absolute achievement, the teacher will consider students of the first group as more successful. However, in terms of relative achievement, students of the first group improved their performance 1.5 times, whereas the students in the second group improved threefold; at the same time, in terms of absolute achievement, students in the first group perform twice as better as students in the second group. Such a lack of coincidence between absolute and relative achievement has led to several important questions.

Relative achievement is nowhere more important as in special school for mentally retarded because students there are absolute underachievers. That is why it is so important to take into account their relative achievement. This concept should be applied, in particular, in schools for the mentally retarded and in cases of underachievement. There are students who constantly receive "fail" grades, the same fail grade appears in their quarterly report cards and sometimes also at the end of the year; thus, there is a particular group of students who [constantly] fails. These students underachieve in absolute terms. However, the fail grade is just a negative description of these children's knowledge of the school syllabus but it does not show what these children have gained in school in general. When I started this study, it became clear that some of these students failed in terms of relative achievement, although others failed in terms of absolute achievement but had an average, and in some rare cases even a high, relative achievement. It is important to distinguish those who underachieve relatively and those who underachieve absolutely. It is very important for educational practice and in some schools and pedological laboratories the following practical rule has been adopted: Only children who systematically display not only absolute, but also relative underachievement can be transferred to special schools. A student with absolute underachievement who shows a certain level of relative achievement (relative to the class) needs changed conditions within his school, but should not be transferred from it. I will attempt to explain this important practical rule both theoretically and in terms of experimental analysis.

Relative achievement is of utmost importance for the dynamics of underachieving students in regular, and all students in special schools. However, relative achievement is also important in regular school for all students because sometimes a student who in absolute terms is at the head of the class is weak in relative achievement. In this way, [the phenomenon] of relative achievement reveals to the teacher the gains of each one of his students. It turns out that in each one of the three groups, with high, medium, and low level of mental development, there are students with high or low relative achievement. Thus, the problem: What is the cause of relative achievement?

To answer this question, I would like to point to the last column of Table 1. Studies demonstrated that if we order all students according to their relative achievement, the following

extremely interesting picture will emerge. The top place in terms of relative achievement will be occupied by students of the third group (with lowest IQ), the second place by students of the first group (with highest IQ), and the third place by students with medium IQ. If we set aside the case of students with medium IQ—the most complex and less investigated cases—we will see that the first and the third groups changed places. Those who in terms of absolute achievement were the best, in terms of relative achievement found themselves behind, and vice versa.

We, thus, found interesting relationships between a child's IQ at the moment of school entry and his absolute school achievement, and between the dynamics of mental development and relative achievement.

Let us turn to studies that could help us answer the question regarding these complex relationships. Obviously, we cannot explore the entire multitude of emerging questions because it would require a whole book to present all the problems and results. Our goal is to identify two to three moments that would clarify the main points of these relationships and chart the way for the practical use of the diagnostics of mental development in schooling. These points will have an immediate practical importance for regular and special schools of today and tomorrow.

The first question that emerged and provides us with at least a tentative answer regarding the aforementioned relationships is the question of the zone of proximal development (ZPD). In the investigation of the mental development of the child, it is typical to consider only what the child is capable of doing himself as indicative of his intelligence. We give the child a series of tests, a series of tasks of varying difficulty, and based on how the child solves the problem and on the level of difficulty, we judge the development of his intelligence. It is common to think that an independent solution of the problem, without any help, points to the level of the [child's] development of intelligence. If we ask him leading questions or demonstrate to him how to solve the task and the child then solves the task after demonstration, or if the teacher starts to solve the task and the child finishes it, or solve it in cooperation with other children, in short, if the child deviates even slightly from the independent solving of the task, such a solution is not considered indicative of the development of his intelligence. This truth was so generally known and supported by the common sense that in the last 10 years, it has not occurred to the mind of the most profound of scholars that what is indicative of the child's intellectual development is not only what he can do himself, but probably more so what he can do with the help of others.

Let us take the simplest case from our studies that can serve as a prototype of the entire problem. I studied two children when they entered school. Both were 10 years old and both had a mental age of 8 years. Can I say that they are intellectually equal? Certainly. What does this mean? This means that they are capable of solving problems that correspond to the norm of 8-year-old children. Once this study is over, one can imagine that the future mental development of these children during their school years will be the same because it depends on their intelligence. Of course, it may depend on some other factors. For example, one child might be sick for half a year, whereas the second one attends school all the time without interruption. But apart from such cases, the future of these children is expected to be similar. Now, let us imagine that instead of stopping my study when I obtain the aforementioned result, I start it again. Both children prove to be of a mental age of 8 years because they are capable of solving tasks attuned to 8-year-olds but cannot solve more complex tasks. I would then demonstrate to them different methods of problem solving. Different researchers and

authors use different methods of demonstration. Some demonstrate a complete problem-solving process and then ask the child to repeat it, or start the solution and then ask the child to continue, or ask leading questions. In a word, in different ways, you prompt the child to solve the problem with your help. Under such conditions, it turns out that the first child is capable of solving tasks up to the level typical of a 12-year-old, whereas the second child up to the level of a 9-year-old. Can one say after this additional investigation that these children are intellectually equal?

When [we] were confronted with this fact for the first time and when it was shown that children with the same level of mental development under the guidance of the same educator are capable of a very different range of learning, it became clear that they are not intellectually equal and that their future in the course of schooling will be different. We call this difference between 12 and 8, and 9 and 8 ZPD. Empirically, it is clear that one 8-year-old child can solve problems of 12-year-olds and the other one of 9-year-olds.

Let us clarify the concept of ZPD and its meaning. We will call the level reached by the child in the course of his development and determined with the help of the tasks that he can solve independently—the child's level of actual development. This definition is becoming more and more accepted in modern pedology. Thus, the level of actual development corresponds to mental age because this term is used in pedology. Right now, we are in the process of rejecting the term *mental age* because as we have seen, it does not reflect mental development. The ZPD of the child is the distance between the level of his actual development, determined with the help of independently solved tasks, and the level of possible development, defined with the help of tasks solved by the child under the guidance of adults or in cooperation with more intelligent peers.

What is the level of actual development? If we ask even the most naive person what the level of actual development is, or in simpler words, what the tasks that the child can solve independently can tell us, then the usual answer would be that the level of actual development of the child is determined by already matured functions, by the fruits of development. If the child is capable of doing this and that, this means that the functions required for doing this and that independently have matured. What then is ZPD determined by the tasks that the child is unable to solve by himself but can solve with help? ZPD defines those functions that are not mature yet, but are currently in the process of maturation, the functions that will mature tomorrow. These functions are not fruits yet, but buds or flowers of development.

The level of actual development characterizes already achieved results of the development, its "yesterday," whereas ZPD characterizes mental development that will take place "tomorrow." How does the maturation of intellectual functions take place? Does it look like a sudden "shot" or as a slow process that has both leaps and zigzags? In short, are there beginning, middle, and end of this process? Of course, there is! Intellectual development of the child is not simpler than the growth of beans or peas in the vegetable garden. The gardener is capable of foreseeing all the stages of the plant development long before the appearance of the crop. Woe betides the gardener capable of determining the state of his plans only at the time of harvest. In the same way, the pedologist is not good if he can evaluate only what has already happened in child development and if he can only summarize the "yesterday" of the developmental process.

Thus, ZPD helps the pedologist and the educator to understand the inner movement, the very process of development, and identify not only what has already been accomplished and borne fruits but also what is currently maturing. ZPD helps to predict what will happen

tomorrow. Let us refer to just one study of the preschool age that demonstrates that what is within the ZPD today, tomorrow will be within the child's zone of actual development. What the child is capable of doing today with the help of others, tomorrow he will be doing himself. American researcher McCarthy (1930) demonstrated that 3- to 5-year-old preschool children have certain fully mastered functions, but also some other functions that children cannot show independently, but only under guidance, in cooperation, and in a group. It turned out that at the age of 5–7 years, this second group of functions is predominantly within the children's zone of actual development. This study thus demonstrated that what at the age of 3–5 years the child is capable of doing only with guidance, at the age of 5–7 years he will be able to do independently. Thus, if we define only the mental age of the child, that is his already matured functions, then we can know the result of already accomplished development, but if we define the maturing functions then we will be able to predict what will happen with the child between ages 5 and 7, if the conditions of the development stay the same.

Thus, the study of ZPD has become one of the strongest tools of pedological investigation that helps to significantly increase the effectiveness, usefulness, and productivity of the diagnosis of mental development as applied to the problems posed by school.

Let us now try to answer the question about the origin of the aforementioned contradiction that appears as a symptom of extremely complex relationships between the child's mental development and his school progress. Because it is impossible to touch on all or even the most important problems, let us focus on just two of them. The first one is that of ZPD. We have already seen in a specific study that children with the same IQ may have unequal ZPDs. Children can be divided according to their IQ, but they also can be divided depending on their ZPDs. Let us call Group A those children whose ZPD is more than 3 years, and Group B those children whose ZPD is less than 2 years. It is clear that children from Groups A and B will be found in all IQ groups. One may have a high IQ and a small ZPD and vice versa. Let us imagine that I selected four students to follow the dynamics of their mental development during school study and their relative achievements. The first student (IA) belongs to Category A—high IQ and large ZPD. The second student (IB) belongs to Group B—high IQ and small ZPD. The third child (IIIA)—low IQ and large ZPD. The fourth student (IIIB)—low IQ and small ZPD. The pairs of first and second as well as third and fourth are similar in terms of their IQ but different in ZPDs. The pairs of first and third as well as second and fourth are similar in terms of their ZPDs but different in terms of their IQ (see Table 2).

If we wish to clarify which of the aspects is most important, let us compare children who are similar in one aspect and different in another and pose a question about the dynamics of their mental development and their relative achievement. If IQ is important, then the development of the first child should be similar to that of the second, and the development

TABLE 2. IQ and ZPD

Category	IQ	ZPD
IA	High	Large
IB	High	Small
IIIA	Low	Large
IIIB	Low	Small

Note. ZPD = zone of proximal development.

of the third child similar to that of the fourth. If on the contrary ZPD is important, then the developments of the first and third, and the second and fourth should be similar. We took as an example just four students, but the study was carried out on a massive scale, so one could have taken 40, 400, or even 4,000 students as long as they could be divided into these four groups.

The results of the studies demonstrated that there is more similarity in the dynamics of mental development and relative achievement between the first and the third child, and the second and the fourth. ZPD is more important and influential for the dynamics of mental development during schooling and for relative achievement than the actual level of mental development at a given moment. In short, for the dynamics of mental development and for school achievement, those functions that are in a process of maturation are more essential than those that are already well developed, the latter being just a prerequisite. What is currently developing is more important.

When some law is [finally] discovered as a result of a continuous effort of scientific thought, it often appears as quite evident. School always focuses on things different from those on which we focus by testing children. At the school entry, we require the child to do what he, himself is capable of doing, whereas the teacher starts working in such a way that the child constantly moves from what he knows how to do to what he does not know. From this purely empirical analysis, it is clear that school study should be determined not so much by what the child is capable of doing himself but by what he can do under guidance.

In even simpler [words], what is important for the school is not what the child has already learned but what he is capable of learning. ZPD defined the child's ability to master under guidance, with help, direction, or cooperation what he still does not have. But the study does not stop here and proceeds further to yet another problem on which I will focus before concluding.

Let us start with a concrete study with which I am quite familiar. Let us call as Category C those literate children who find themselves in school among literate children and illiterate ones who find themselves among illiterate children. Group C is a group of children who find themselves among those similar to them. Let us call as Category D those children who are not very numerous in Moscow and Leningrad but abound in the provinces and who find themselves among children of an opposite group—literate among illiterate and illiterate among literate. I believe you would agree that categories C and D can be found among all children with both high and low IQ. Let us follow our investigation in the same way as we did it with Groups A and B. Let us take four children (but we could take 400 or 4,000) and define them as IC, ID, IIIC and DIII (see Table 3).

Let us now ask ourselves where we will find greater similarity in terms of mental development and relative achievement—between those who are similar in IQ (i.e., IC and ID, and

TABLE 3. IQ and Literacy Conditions

Category	IQ	Conditions
IC	High	Literate with literate or illiterate with illiterate
ID	High	Literate with illiterate or illiterate with literate
IIIC	Low	Literate with literate or illiterate with illiterate
IIID	Low	Literate with illiterate or illiterate with literate

IIIC and IIID) or those who are similar in conditions (i.e., IC and IIIC, and ID and IIID). Each child is similar to another in only one parameter. Which one of these parameters has a greater impact on school achievement and dynamics of mental development? The study demonstrates, even more strongly than in the case of ZPD, that similarity is greater between children under the same conditions rather than with the same IQ (i.e., IC and IIIC, and ID and IIID). This means that for the dynamics of mental development and for school advancement, the decisive factor, it is not an absolute value of IQ but the relationship between the level of development and preparation of the child for school requirements. This last parameter, the level of school requirement, is currently called in pedology an "ideal mental age." I think this is a very important concept. Let us imagine that the child finds himself in the fourth grade. What mental age should he have to be the best student and maximally achieve in education and mental development?

This ideal mental age can be identified empirically by studying the best students in different grades. We can also do as other researchers are doing and translate the level of school requirements into educational age. Methodologically, this question is very complex and important and I am not going to discuss it now. In any case, I think that you understand the meaning of the ideal mental age for a given school grade. This is the level and character of the mental development of the child that allows him to move with maximal success by coping with grade requirements. It turns out that the most important and sensitive parameter among those identified by pedological study is the ratio between the ideal mental age of the grade and the real mental development and preparedness of children in a given class. Not every ratio is favorable, but only that within a certain range, in the same way as not every temperature is favorable for the body, just only about 37°C. If this ratio is shifted in the direction of acceleration or deceleration of mental development, then relative school achievement will also be impaired. Of course, the direction of the shift is important, it is not the same when an illiterate child finds himself in a class of literate students where the ideal mental age greatly exceeds his actual mental age and where he will experience extreme difficulties, and the situation of a literate child in a class of illiterate students where the ideal mental age is lagging behind. However, a certain impairment will be observed in both cases.

These are the initial data that have led to a special study. It turned out that the similarity is not only between IC and IIIC. This is relatively easy to understand because literate were studying with literate and illiterate with illiterate, but also between ID and IIID. ID is a group of children with high IQ who found themselves with students who were opposite in terms of literacy. Here the question becomes more complicated. We imagine that it is very easy for a literate child to study with illiterate children. He can do almost nothing and still be the best student. On the other hand, for an illiterate child, it is very difficult to follow studies in a class of literate students. He will work hard but still fail to catch up. Thus, the gap between the ideal age and the actual age in both directions will lead to a certain deficit of relative achievement and the dynamics of mental development, but not in equal measure. A simple analysis shows that a literate child in a class of illiterates will learn very little, and an illiterate child in the class of already literate children will learn little.

From this and other studies, the idea emerged that, apparently, there is an optimal distance and optimal gap between actual mental development and the development required in a given classroom. Education should pose the higher demands (for mental development) and should be based on currently developing rather than already matured functions. Oehl said that learning is good if it runs ahead of development and pulls it. Learning should evoke,

organize, and lead the process of development, use it as a springboard, but should not rest on already matured functions. This can be understood in such a way that the dynamics of mental development will suffer both in cases when the ideal age is too close to or even lower than the actual age, and in cases when the actual age is so low that the gap is too wide. Therefore, we need to answer the question about the optimal distance and the optimal conditions of mental development. How can one in practical terms define what educators call the zone of feasible difficulty of classroom study for a given child? Everyone knows that study that is too easy or too difficult is ineffective. Attempts to define this optimal zone have been made. This zone has been defined in terms of children's mental age, curricular material, and time. These studies were conducted with individual students, so they are not based on large statistical materials, but they seem to respond to the previous question. The optimal distance coincides with the child's ZPD. Therefore, for a child whose actual mental age is 8 years, the ideal mental age of the class should be 10 years. The ideal mental age of the class coincides with the child's ZPD. When such a matching takes place, we have the optimal conditions for the child's development.

When we recall the long and complicated way in which human thought came to this conclusion, it seems that each one of us could come to the same conclusion at least as a guess, and yet even the greatest of the researchers failed to notice it. A short time ago, we said that school does not need to teach the child what he already knows but what he can do under guidance. We also defined ZPD as an index of intelligence that is based on guided performance. Therefore, ZPD should define the optimal conditions [of learning]. In this way, ZPD becomes not only an excellent means for the prognosis of the dynamics of mental development and relative achievement but also a means for the composition of classes. This will define for the schoolchildren the following four parameters: the level of mental development of the child, his ZPD, the ideal age of the class, and the relationships between the ideal age and ZPD. This [approach] provides us with the best tool for deciding about the composition of the class. I will complete on this point the presentation of the factual material, because my presentation did not aspire to goals beyond the review of the problem of diagnosis of mental development as it has appeared in the last 10 years.

As a conclusion, I will touch on two additional issues. The first one is the question of why classical psychology considered only those things that the child can do himself as an index of child intelligence. This is because the processes of learning and imitation have been misconceived as purely mechanical processes. If I came to some conclusion based on my own experience that was considered a sign of my intelligence, but if I imitated something, [it was ignored] because one can imitate anything and everything. Psychologists have revealed this approach as erroneous. One can imitate only those things that are within one's zone of abilities. For example, if I experience difficulty in some arithmetic problem and you start solving it on the blackboard, then I will immediately be able to solve it. On the other hand, if you start solving a problem from higher mathematics, and I do not know it at all, no amount of imitation can help me. Clearly, we can imitate only those things that are within our own zone of mental experience. This problem has been resolved in zoopsychology, thanks to the work of Köhler (1921). His experiments aimed at solving the problem of whether apes are capable of perceptual thinking. Typically, the question has emerged whether the ape solved the problem independently or based on observational experience. The ape might previously see how some action was performed by other apes or might see people using sticks and other tools and imitated their behavior. For example, one of the apes arrived on the ship where

it observed how sailors scrubbed the deck with brooms and used poles to fix something or pull something down from a high-up place. Thus, there was a doubt whether the ape [later] performed these operations independently or imitated them. To resolve this problem, Köhler conducted special experiments. It turned out that an ape expected to imitate movements beyond its mental development is in the same sorry position as I am when confronted with the task of imitating the solution of the higher math problems. Thus, it appeared that the ape is capable of using imitation only with the tasks that are within its own range of abilities. A remarkable fact that Köhler did not take into account is that the ape cannot learn through imitation in a human sense, it cannot develop its intelligence because it does not have ZPD. The level of difficulty in the ape's own problem solving is the same as in imitated problem solving. The ape cannot use guidance and learning to develop in its ability to solve similar problems independently. What can be done is to train the ape in mechanical skills, or to combine its existent intellectual skills, to train it how to ride a bicycle, but to teach it how to independently solve more intelligent problems is impossible. That is why in animals, learning and teaching in the human sense of the term is impossible because it presupposes some specific social nature, the ingrowth of the child in the mental life of other people. Some followers of Köhler claimed that a human child's imitation also does not go beyond his [mental] age. However, even minimal critical examination showed that such a claim is absurd. We know that a child's development and learning are based on the ability to improve thinking not just through training, as in apes, but also as an individual action. One of Köhler's coworkers claimed that although in the ape there is no difference between the independent intellectual level and the level demonstrated via imitation, in the human child such a difference does exist but it is fixed. That is, if the child's mental age is 8 years, then under guidance he can solve the problems for 10-year-olds, thus his ZPD is fixed and determined by the level of actual development. Such an opinion is based on pure prejudice but it was popular for several years. If that was indeed so, there would have been no reason to evaluate ZPD for each individual child because their ZPD were the same. Experimental studies demonstrated, however, that for one of the two 8-year-olds ZPD reaches the age of 10 years, and for the other 9-year-olds. Thus, ZPD is not constant.

Now, I would like to show how the problems discussed today can help in practice. I will present this very schematically because each educational application is complex and multifaceted and requires a special consideration. Let us return to our table. What has been clarified in these contradictions? Is it possible to pose the question of achievement and the dynamics of mental development of the child with high IQ in a general way? We saw that there are children with different ZPD, we also saw that there are children with different relationships between themselves and the educational requirements of their class. If we combine these parameters, we will have several groupings. Are these groupings important for mental development and relative achievement? Yes, they are the most essential features. All groups arranged according to their IQ (see Table 1) proved to be heterogeneous, and the observed regularities were purely statistical. They obscured rather than clarified the true regularities because it is impossible to arrive at the general law when you [statistically] work with qualitatively different entities.

Can one conclude as a general rule that children with high IQ tend to lower it during school study? No, one cannot do this because one should take into account the type of these children, such as whether they are literate, illiterate, and so on. Then why do we see a statistical tendency? I will explain this by giving the following example. What is IQ? IQ is a symptom

or a sign, but do we know the cause of this symptom? Let us take the field of medicine that deals with symptoms. Is it true that most people who have a cough will be cured without any medication if they stay at home for three to seven days? If we take the months of October and November when most people with coughs have flu, then we can reach such a conclusion but this "law" will be wrong because it depends on sheer coincidence. If I take patients with coughs in a hospital where there are people with tuberculosis, my law will prove incorrect. The same applies to the month of May when there are less people with flu. Thus, we have a spurious statistical regularity when in a heterogeneous group, most belong to a certain type, and regularity is true for this subgroup but we erroneously perceive it as a general rule.

Why do children with initially high IQ have a tendency to lower it during the 4 years of primary school? Most of these children, more than 70% of them, are not more intellectually gifted than others but they grew up in more favorable [family] conditions. For example, in Germany, schooling starts at the age of 6 years, whereas here (in Russia) at the age of 8 years. The child at the age of 6 years is capable of learning the rudiments of school wisdom—literacy, arithmetic, reading, and writing. One child grows in a cultured family that has books and he is shown letters, and read to, whereas the other child grows in family where he did not see a single letter. We test these children with the help of intelligence tests, like those of Binet that are attuned to the school knowledge and skills of the children. Little wonder that children from more cultured families demonstrate a higher IQ. The opposite would be surprising. From where did these children acquire their high IQ? They acquire it from their ZPD; they "ran through" their ZPD rather quickly and then they were left with relatively small ZPD because they had already used it. According to my data from two schools, there are about 57% of such children.

What happens to these children? First of all, by the type of their mental development, these are children with small ZPD so they are expected to show the poor dynamics of schooling. Why then did they acquire a high IQ? Because of the good [initial] conditions of cultural development, in school, these conditions are equalized. After 4 years of schooling, children with low and high IQ have a tendency toward convergence. The low IQ that in our case is determined by the poor initial conditions improves because the child's conditions in school are better. For the children who grew up in privileged circumstances, the conditions become relatively worse. If we have 57% of these children, then this regularity will be statistically justified. The question is whether this justification is of the same nature as in the case of the cough when regularity depended on the incidental predominance of a certain group. Of course not. Thus, for the first time, it becomes possible to move from qualitatively unarticulated global statistical values to much deeper analysis.

Practical applications of the issues discussed today are carried out in different directions. The foremost importance [of these applications] are in diagnosis, selection of mentally retarded, evaluation of achievement and underachievement—both global and partial—identification of latent achievement of failing students, problems of class composition, and the question of whether schooling contributes to the general development of the child or only to acquisition of certain knowledge. In short, it seems that it is difficult to find any practical problems of schooling that are not connected to the previous issues. It seems to me that if we move from the traditional question of whether the child is ready for study at a given age to a deeper analysis of the mental development of the child in the process of teaching and learning, then all pedological problems in both regular and special school will appear in a new light.

NOTE

1. This article was originally published in Russian: Vygotsky, L. S. (1935). Dinamika umstvennogo razvitija schkol'nika v sviazi s obucheniem. In L. V. Zankov, Zh. I. Shif, & D. B. Elkonin (Eds), *Umstevennoe razvitie detej v processe obuchenija* (pp. 33–52). Moscow-Leningrad: Uchpedgiz.

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