

The zone of proximal development during assessment of intellectual development in pre-school children

Yulia Solovieva*, Luis Quintanar

Faculty of Psychology, Autonomous University of Puebla, Puebla, Mexico

*Corresponding author. E-mail: yulia.solovieva@correo.buap.mx

The zone of proximal development is a well-known and frequently referenced term within cultural historical psychology. Nevertheless, it is rarely used in the concrete practice of assessing intellectual development. The majority of proposals for such assessment are based on a behavioral and psychometric conception of development. This study presents a Scheme for Evaluation of Intellectual Development based on the concept of the zone of proximal development and on gradual intellectual development. The Scheme was applied to 160 Mexican pre-school children from rural, suburban, official, and private kindergartens. The Scheme permitted us to determine the zone of proximal development by evaluating the children's level of external orientation during the solution of new intellectual tasks. Three levels of orientation through external help were established. The results showed that the majority of children from all groups managed to fulfil new tasks after receiving external help, which indicated the existence of their zone of proximal development. Differences were detected in the use of the level of help in all groups. Statistical analysis showed a significant correlation between the level of helping received, the degree of fulfilment of the task, and the children's socio-cultural group. The results permitted us to establish more precisely the zone of proximal development at pre-school age. We discuss how the concept of the zone of proximal development might be used in concrete psychological practice and research, instead of being only a well-known term at a declarative level.

Keywords: intellectual development, zone of proximal development, level of development, preschool development, assessment of intellect, assessment of development, intellectual actions

Introduction

Prominent psychologist L.S. Vygotsky (1991) proposed the concept of the zone of proximal development in the third decade of 20th century. However, it was only years afterward that some psychologists began to elaborate concrete proposals for understanding this concept by presenting new cognitive tasks to children and adolescents (Feuerstein, 1979). There are still very few studies that apply this concept

for diagnosing children's intellectual development. The majority of intellectual tests provide no help or orientation during the evaluation procedure, and are based on assessment of the possibility or impossibility of the child's achieving a solution, or answering a question, as in WISC tests (Weschler, 1987). The use and citation of such tests have become an undeclared prerequisite for publication in prestigious psychological and clinical journals. Any other kind of proposal for qualitative or interventional assessment within psychology and neuropsychology is normally strongly criticized, and misunderstood. Behind the usage of psychometrical tests, one possibly finds the conception that cognitive abilities are inherited. Orientation or external help for the child makes no sense, if the research goal is evaluating static (inherited, unchangeable) features of intellect based on the normal statistical distribution inside each population, with norms for each chronological age.

Another conception of development was expressed by psychologists such as Piaget (1973), Wallon (1942), and Zaporozhets (1986), who have studied the process of intellectual ontogenetic development in depth. Two particular lines of development have been identified in this process: functional (quantitative) development, and development by stages or forms (qualitative intellectual development) (Zaporozhets, 1986).

The time line of functional development shows enrichment of the content of the child's thinking — that is, acquisition of new actions and the gradual interiorization of these actions (Galperin, 1998; Obukhova, 1995; Talyzina, 1984). According to Zaporozhets (1996), changes in the content of the intellect are carried out along with the reorganization of levels (stages) of intellect. The important characteristic shown in the time line of the child's qualitative intellectual development is the appearance of new forms or levels of intellectual activity.

These forms or stages of intellect are: 1) the stage of concrete actions; 2) the stage of concrete images, or perceptive level; and 3) the stage of logical-verbal intellect (Zaporozhets, 1996; Elkonin, 1989, 1995; Poddyakov, 1977, 1996). At the stage of concrete actions, a child operates with real objects. At the stage of concrete images, a child fulfills cognitive tasks with representations of objects. At the stage of logical-verbal intellect, a child operates on the verbal level with no need for any kind of representation. Such an understanding of stages or forms of intellectual development might be enriched by including the stage of materialized actions, a stage at which a child may fulfill intellectual actions with external symbols or substitutions for real objects (Salmina, 1984; Talyzina, 2002). A similar stage might be found at the perceptive level, when a child doesn't operate with concrete representations, but with symbolic representations or schemes. In this case, the forms of possible realization of intellectual tasks might be as follows: concrete or material actions; materialized external actions; perceptive concrete actions; perceptive symbolic actions; and verbal (oral, written or completely inner) actions. It is important to note that the actions might be practical, repetitive, and communicative at all these levels.

In this study we used only the possibility of fulfilling intellectual tasks which might be considered solving problems. Intellectual problems always require previous analysis of initial conditions, synthesis of the essential features of the problem, and later generalization of the possibility of transferring the action to similar new conditions (Rubinstein, 1989). Galperin (1998) and Davydov (2000) also consid-

ered generalization an important feature of acquired intellectual action. We may assume that actions which do not require previous analysis of initial conditions, synthesis, and generalization, cannot be part of the class of intellectual actions.

The existence of quantitative and qualitative lines of intellectual development means that it is necessary to create diagnostic methods for both (Karpov & Talyzina, 1986; Talyzina & Karpov, 1987). The functional or quantitative line is used in the majority of psychological or psychometrical tests (Weschler, 1987). Such methods of evaluation of the level of children's intellectual development are being strongly criticized by many modern authors (Sternberg, 1985; Gardner, 1996). To use Vygotsky's terms (1991), such tests can only evaluate the zone of *actual* development, or the level of the child's actual knowledge or habits.

The evaluation of the qualitative line of intellectual development reveals another dimension. Russian psychologists who subscribe to the historical and cultural conception of development, have made the most significant efforts along this path in previous years (Talyzina & Karpov, 1987; Karpov & Taliizna, 1989). Our own research in this area represents a continuation of that orientation (Solovieva & Talyzina, 2002; Solovieva & Quintanar, 2004, 2012; Solovieva, 2004, 2014; Solovieva & Cols., 2013). We have designed and had approved a special method for diagnosing the intellectual development of pre-school and school children. This proposal is based on two theoretical principles: the social genesis of psychological functions (Vygotsky, 1982), and activity theory (Leontiev, 1975).

According to this approach, the evaluation of intellectual development means determining at what stage a child can realize a new task, and/or at what stage he or she can accept the orientation of the adult. Such orientation could be provided at different levels (proceeding step by step), using operations which conform to the action (Solovieva, 1999). Such steps of helping are broadly used in programs of correction in the modern child neuropsychology of Luria's school (Pylayeva & Akhutina, 1997) and pedagogical psychology (Salmina & Filimonova, 2001, 2010). The orientation might be presented at any point in the development of actions: concrete, materialized, perceptive, perceptive symbolic, or verbal.

The purpose of the present study is to propose a new way of diagnosing the intellectual development of pre-school children, which may be used in psychological practice and research instead of psychometric quantitative assessment. Our proposal is based on the use of gradual orientation, or help, for a child to fulfill new intellectual tasks, instead of assessing known or developed abilities. The concept of the zone of proximal development for new intellectual actions which are presented to the child in a situation of collaboration with an adult, includes two main aspects: 1) the stage at which a child acts after working with the orientation provided by an adult, and 2) the amount of this orientation offered by the researcher.

Method

Subjects

160 pre-school Mexican children of both sexes from kindergartens in the State of Puebla were selected. The age of the children was between 5 and 6 years (there were no children younger than 5 years old, nor children older than 6 years). There were no statistical differences between average age in the groups, which was 5.6.

The children were divided into four groups according to their social status. Group 1 included 40 children from a rural zone. Group 2 was comprised of 40 children from a suburban zone. Group 3 included 40 children from a lower-income urban zone. Group 4 consisted of 40 children from a higher-income urban zone (private kindergartens). All children attended official preschool Mexican institutions and were regular pupils. The distribution of groups by social level (rural, suburban, urban, and private) was accomplished by applying the educational institutions' official system of classification of social zones determined by formal living conditions.

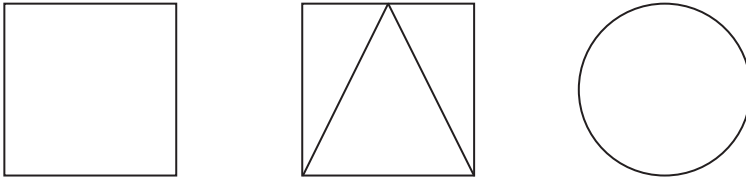
Procedure

The Scheme for Evaluation of Intellectual Development (Solovieva, 2004) has been applied. The Scheme does not precisely evaluate the zone of actual development of a child. The objective is to characterize the zone of proximal development according to the potential fulfillment of new intellectual actions on a materialized, perceptive, or verbal level. We understand determination of the zone of proximal development to mean establishing how co-operation with an adult helps a child solve a new problem, and at which level of action this new accomplishment might be realized. The fact that the task is new for a child is an essential part of the evaluation. Only the formative experiment permits us to determine the zone of proximal development (Vygotsky, 1991; Davydov, 1988; Talyzina, 1998). So, the Scheme evaluates the qualitative characteristics of the child's intellectual development in his/her zone of proximal development. The Scheme allows us to determine the stage of realization of the new action, after proposed orientation at the same stage (for, instance, stage of concrete actions or perceptive actions) and establishes the amount of help needed during this orientation.

An assessment of intellectual development by the presentation of new cognitive tasks with an external orientation for the solution was administered to all the children. First, the researcher verifies whether the task is new for the child or not. If the task is new, the orientation base of action (Talyzina, 1984) was provided. At the stage of elaboration of the orientation base of action, the researcher explains to the child the whole procedure for solving the problem, working in the zone of child's proximal development. Diverse levels of external help were presented to children step by step, according to operations of cognitive action. After that, the stage of intellectual development in the zone of proximal development was determined by presenting similar (not the same) cognitive actions on the following levels: verbal, perceptive, or materialized actions. The child's potential to fulfill new intellectual actions on one of the levels, was considered an accessible level of working in the zone of proximal development: verbal, perceptive, or the level of materialized actions. If the child was not able to fulfill the new action at any of the mentioned levels, even after working on the stage of orientation, we concluded that such intellectual action was not accessible to the child, at least at this very moment.

Experiment

The task presented by the experiment was for the child to use a logical sequence to find the fourth figure in a series, which has to differ from the third one in the same way that the second figure differs from the first.



Example 1. shows the initial task: square, square with triangle, and circle.

The task was presented on a materialized level with the help of plastic geometrical figures. During the experiment the child was shown the sequence of three given figures, and was asked to complete the sequence by finding the missing fourth figure. The fourth figure had to differ from the third figure exactly as the second differs from the first one. No orientation is presented at the stage of the initial presentation of the task. If the child was able to find the fourth figure, we concluded that this intellectual action was not new for this child. If the child was not able to find the correct figure, the psychologist started to work within an orientation base of action according to the cognitive operations required to fulfill the intellectual task.

The cognitive action used in our experiment includes three consecutive operations:

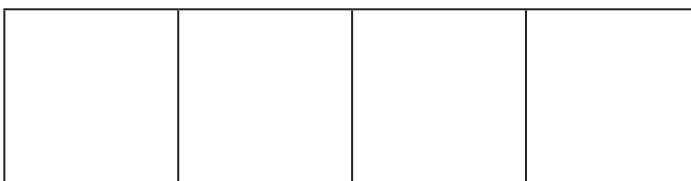
- 1) The first operation consists of identifying the difference between the first and the second figures.
- 2) The second operation consists of finding the basic structure of the last figure, similar to that of the first figure.
- 3) The third operation consists of completing the fourth figure by adding the essential element of the fourth figure (base).

During the experiment, the orientation base of action was also presented on a materialized level.

Orientation

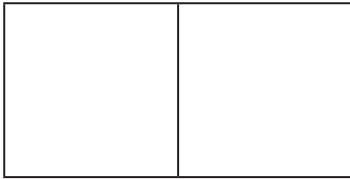
During the stage of orientation, the researcher puts the figures in front of the child above a schema of empty squares. There are no figures in it, but the required places are marked for each figure (*Example 2*). Different geometrical figures (circles, squares, and triangles) are on the table in front of the child in no particular order. The psychologist will put the necessary figures in front of the child in order to provide adequate orientation for the solution of the logic sequence.

The psychologist starts to give the orientation base of action according to the three previously mentioned operations, which represent the three possible levels of help (reduced, incomplete, and complete).



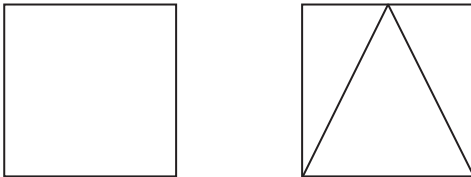
Example 2. Stage of orientation: a schema with spaces marked for the figures

In the case of the reduced orientation, the researcher directs the child's attention and explains that the second figure is different from the first one because it has a triangle inscribed in it. After that, he asks the child to find the fourth figure, which has to differ from the third one, as the second figure differs from the first one. If the child succeeds, it means that he/she needed the first level of help in the orientation base of action. The reduced level of external orientation is enough in that case. *Example 3* shows the reduced orientation.



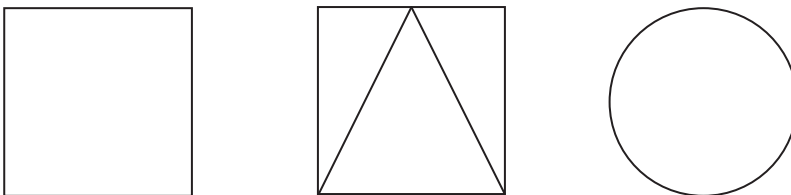
Example 3. Reduced orientation: square, square

If the child makes a mistake, or expresses lack of understanding, the researcher proceeds with the second level of help. He once more shows the child the difference between the first and the second figures. After that, the researcher mentions that the base of two first figures is the same, and this is the similarity between figures. The psychologist stresses the presence of similarity (same base) and the difference (the figure inscribed) between the first and the second figure. *Example 4* shows the level of incomplete orientation.



Example 4. Incomplete orientation. Square, square with triangle

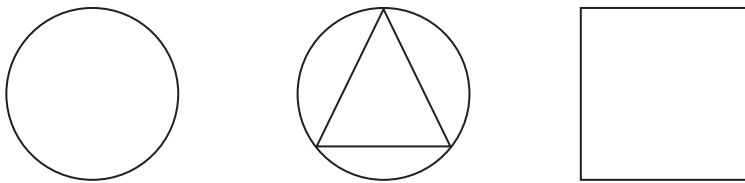
If the child succeeds, it means that he/she needed the second level of help, or incomplete orientation. If the child is unable to find the fourth figure correctly, the researcher continues to work with the orientation, and presents the complete orientation base of action. The researcher starts from the very beginning, explaining and showing all the differences and similarities between the figures, and solving the whole problem in front of the child's eyes. This is the third level of help, or complete orientation. *Example 5* shows complete orientation.



Example 5. Complete orientation: square, square with triangle and circle

So, during the stage of complete orientation, the researcher shows all the steps of the task gradually, if needed, and explains to the child how it should be solved. The stage of the orientation base of action is complete when the child manages to solve the problem independently. There are no limits on the number of times the explanation is repeated during the work with the complete orientation base of action.

After presenting the orientation base of action, the researcher verifies the level of child's potential development, or zone of proximal development. In order to do so, the psychologist offers similar new tasks (never the same task) to the child gradually on verbal, perceptive, or materialized levels. An example of a similar task could be a sequence of a circle, circle with triangle, and a square, where the child is asked to find how the fourth figure differs from the third exactly as the second differs from the first. If the child answers correctly on a verbal level, the experiment concludes, and the level of realizing the answer is verbal. The same thing takes place on the level of images and of materialized actions. *Example 6* shows this task, which could be presented on a perceptive or materialized level, according to the potentialities of each child.



Example 6. Logical sequence: circle, circle with triangle, and square

No orientation is used during verification. The orientation base of action permits us to see whether the child can reach a complex level (verbal presentation and solution) after its presentation at the stage of materialized actions.

The level on which the child fulfills the intellectual action, after the presentation of the orientation base of action on one of its levels of help, points out the potential zone of his/her intellectual development. It means that the child is able to work at this stage after accepting the orientation base of action on the level of materialized actions. The zone of proximal development is determined according to the stage of the child's fulfillment of the new cognitive task, after potentially accepting the orientation base of action presented by an adult during collaboration.

Results

The results obtained in our study indicated that the task presented was new for the majority of children in all socio-cultural groups. Only 15 children (9.37%) were able to solve the initial problem without the orientation base of action. In the rural and suburban groups, the task was not new for only 1 child (2.50%); in the urban group, it was known to 6 children (15.00%), and in the private group to 7 children (17.50%). In the suburban group, there were no children who were able to fulfill the task before the presentation of orientation. *Figure 1* shows these results in the four social groups. The statistical analyses (Anova Oneway) showed a significant difference ($P > 0.001$) between pairs of groups in relation to the potential for solving the

initial cognitive task without orientation. These pairs of groups were: 1) rural and suburban, and 2) urban official and urban private. No differences were found between rural and suburban, nor between urban official and urban private groups.

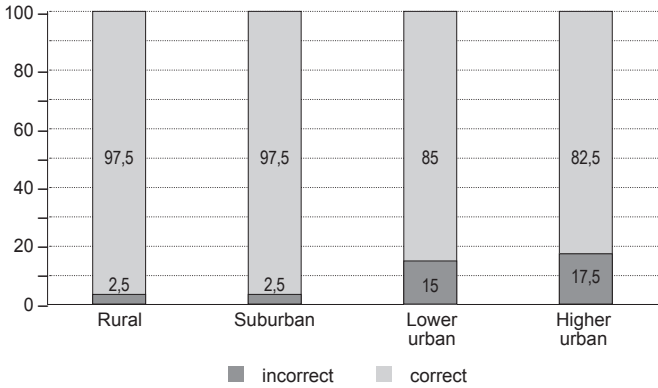


Figure 1. Percentage of subjects with correct and incorrect answers in the first task

Such data allowed us to confirm that the proposed intellectual actions were new for the children, or were not acquired by them in previous contexts. In that case, the adult started the work with an orientation to the children’s fulfilling these new intellectual actions. After the work with orientation, new intellectual actions were presented gradually in verbal, perceptual, and material forms.

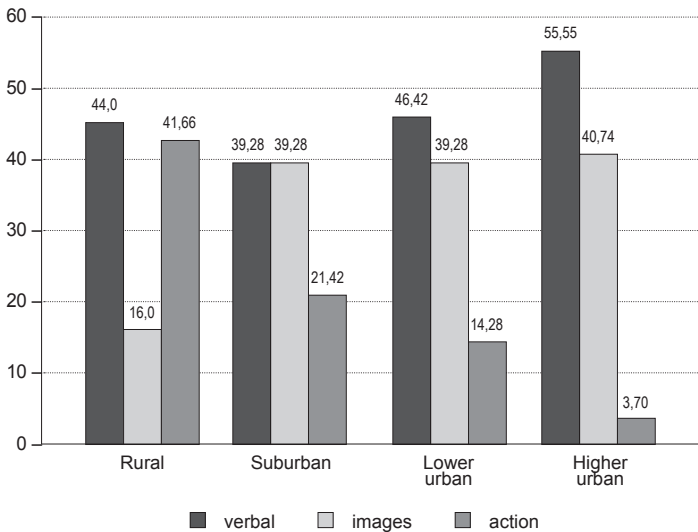


Figure 2. Percentage of subjects with correct answers after orientation base of action at different levels

The results were as follows. After the presentation of the orientation base of action to the rest of children, the majority managed to fulfill the task on one of the levels (verbal, perceptive, or materialized actions). The surprising fact was not only

that the children were able to solve a new task, but that the majority of children from all socio-cultural groups could do it in the stage of verbal thinking. These results are shown in *Figure 2*.

Another interesting finding was that the majority of children needed complete help at the stage of orientation. However, some differences could be noticed between the groups as shown below.

1) *Rural group*. The orientation base of action was presented to 39 children. 64.10% (N=25) of them fulfilled the task after orientation, and 35.89% (N=14) couldn't fulfill the task after presentation of the orientation base of action. 44.00% (N=11) performed on verbal level; 16.00% (N=4) on perceptive level; and 41.66% (N=10) on level of materialized actions.

Levels of help during orientation in the rural group. Only one child required the first level of help (2.56%). He fulfilled the task on a verbal level (9.09% of all children who performed at this level). 17.94% (N=7) needed the second level of help to solve the problem. Of them, 27.27% (N=3) fulfilled the task on the verbal level; 20.00% (N=2) on the level of actions, and 14.28% (N=2) were unable to realize the task at any level. 79.48% (N=31) received complete help. Of them, 63.63% (N=7) performed on the verbal level; 100% (N=4) fulfilled the task on the perceptive level. 80.00% (N=8) completed the task on the level of materialized actions, and 85.71% (N=12) failed.

2) *Suburban group*. The orientation base of action was presented to 39 children. 71.79% (N=28) of them fulfilled the task after orientation, and 28.20% (N=11) couldn't fulfill the task after presentation of the orientation base of action. 39.28% (N=11) of children performed on the verbal level; 39.28% (N=11) on the perceptive level, and 21.42% (N=6) on the level of materialized actions.

Levels of help during orientation in the suburban group. None of the children required merely the first level of help (0.00%). 10.25% (N=5) needed the second level of help. Of them, 9.09% (N=1) fulfilled the task on the verbal level; 18.18% (N=2) on the perceptive level; 16.66% (N=1) on the level of actions. 89.74% (N=35) received complete help. Of them, 90.9% (N=10) performed on the verbal level; 81.81% (N=9) on the perceptive level; 83.33% (N=5) on the level of actions, and 11 children failed to complete the task after orientation.

3) *Urban group*. The orientation base of action was presented to 34 children. 82.35% (N=28) of these children fulfilled the task after orientation, and 17.64% (N=6) couldn't fulfill the task after presentation of the orientation base of action. 46.42% (N=13) performed on the verbal level; 39.28% (N=11) on the perceptive level, and 14.28% (N=4) on the level of materialized actions.

Levels of help during orientation in the urban group. Only one child required only the first level of help (2.94%). He failed to fulfill the task (16.66%). 14.70% (N=5) needed the second level of help. Of them, 9.09% (N=1) fulfilled the task on the verbal level; 18.18% (N=2) on the level of images; 16.66% (N=1) on the level of actions. 82.35% (N=28) received complete help. Of them, 90.9% (N=10) performed on the verbal level; 81.81% (N=9) on the perceptive level; 83.33% (N=5) on the level of materialized actions, and 83.33% (N=5) failed to fulfill the new intellectual task.

4) *Private group*. The orientation base of action was presented to 34 children. 81.81% (N=27) of them fulfilled the task after orientation, and 18.18% (N=6)

couldn't fulfill the task after presentation of the orientation base of action. 55.55% (N=15) performed on the verbal level; 40.74% (N=11) on the perceptive level, and 3.70% (N=1) on the level of materialized actions.

Levels of help during orientation in the private group. Only one child required only the first level of help (3.03%). He fulfilled the task on the verbal level (6.66%). 21.21% (N=7) needed the second level of help. Of them 26.26% (N=4) fulfilled the task on the verbal level, and 27.27% (N=3) on the level of images. 75.75% (N=25) received complete help. Of them 66.66% (N=10) performed on the verbal level; 72.72% (N=8) on the perceptive level; 100% (N=1) on the level of materialized actions, and 100% (N=6) failed to solve the new proposed task after orientation.

Table 1 shows the usage of the various levels of help in different social groups.

Table 1. The usage of levels of helping in different groups

Level of Helping	Groups			
	Rural	Suburban	Urban	Private
1 (N=3; 2.06)	2.56	–	2.94	3.03
2 (N=23; 15.86)	17.94	10.25	14.70	21.21
3(N=119; 82.06)	79.48	89.79	82.35	75.75

Table 2 shows the performance of children from the different social groups after working with orientation presented by the adult.

Table 2. Percentage of performance in different groups

Group	Levels		
	Verbal	Images	Actions
Rural	44.00	16.00	41.66
Suburban	39.28	39.28	21.42
Urban	46.42	39.28	14.28
Private	55.55	40.74	3.70

Discussion

Our results permit us to stress some important points in relation to intellectual development at preschool age. First of all, the task of cognitive sequence, which required analysis and synthesis of specific elements, was new for the majority of children in all social groups. The children responded positively to the proposition of mutual collaboration with the researcher, and accepted the orientation provided. The majority of children were positively sensitive to the presented external orientation, and the proposition to work together in order “to understand how to solve interesting difficult problems.” The children’s emotional involvement was total, and they asked for more time and more “problems” rather than returning to their usual work in the classroom with the teacher.

Additionally, there was the unexpected result that the majority of children in all groups performed at a verbal level after the presented orientation. The bulk of experimental research on testing for intellectual development has always expressed the opinion that the verbal level is not accessible to preschool children, especially those in socially deprived conditions of life (DeLacey, 1970; Cole & Scribner, 1977; Lautrey, 1985). In a later publication, Cole stressed that cognitive complex tasks are not accessible to children and adolescents from rural regions of Yucatán in Mexico (Cole, 1997). Similar findings exist about the black population in the United States, who do not succeed in fulfilling complex cognitive tasks on all psychometric tests (Lumsden & Wilson, 1981). It is necessary to realize that in all those types of research, no kind of external orientation or levels of help were ever provided.

We stress once more that the role of the presentation of external orientation adequate to the structure of the task is a significant factor in determining the potential of preschool children. The orientation base of action, created according to the internal structure (psychological content of intellectual action), positively changes the child's perception of the whole problem, and may even lead to further generalization of the new action. The obvious support for such generalization was the fact that the children were able to fulfill the task on the verbal level after the orientation base of action was presented on a materialized level.

At the same time, it is possible to note interesting differences between the social groups. It is obvious that greatest number of children from the rural group found the fulfillment of the initial task impossible. We also found in this group the highest percentage of children who weren't able to fulfill the task after the presentation of the orientation base of action. That doesn't mean, however, that it would be impossible for them to acquire the ability to solve such problems. We can only conclude that at the present moment, and within the conditions of our experiment, the action was not accessible to them even after orientation. We assume that providing expanded external orientation and work at the material level (concrete actions) instead of at the materialized level (geometric abstract figures), would be a suitable method for preparing these children to succeed.

Our experiment found that the children from different groups showed a clear difference in their needs for the stage of materialized actions. A progressive decrement in performance at this stage can be discerned from the rural to the private group. The level of fulfillment of intellectual task was not the only criterion for determining the zone of proximal development. It was shown that children differed one from another not only by their intellectual level for the solution of the problem, but also by the volume (extent) of orientation needed (from reduced to complete). We may say that at the preschool age, the most appropriate level is complete orientation, instead of reduced or incomplete. What we mean by this is that, from a pedagogical point of view, it is convenient to provide complete orientation and assist in the solution of intellectual problems within day-to-day educational practice.

Little children are totally interested in new cognitive problems, and accept new forms of cooperation with an adult. Such ideas confirm the importance of the consideration of the zone of proximal development in the assessment and teaching process as well (Vygotsky, 1984, Talyzina, 2000; Galperin, 2000). In-

stead of this, different modern theories of education and development make a claim to individual constructivism, without any kind of specific orientation and constant use of previous experience (Ferreiro, 1985; Olmos Roa, 2002; Morales & Olmos Roa, 2002). Thus, the whole application of Vygotsky's theory is reduced to constant repetition of the significance of social context and collective collaboration, without stressing the objectives of each psychological age, or features of cultural knowledge which the child has to acquire (Wertsch, 1989; Rogoff, 1993; Feuerstein & Cols., 1980; Hernández, 2014). We believe that understanding the necessity for creating and providing specific orientation for each type of intellectual activity, or introduction to theoretical concepts (Davydov, 1998, 2000; Ilienkov, 2009), remains one of the dominant goals of educational psychology today. Activity theory applied to teaching has proposed useful means for analyzing the operations and content of intellectual actions with concepts, which may help to provide and apply procedures of orientation while assessing and teaching preschool children.

Limitations

The authors are aware that these results do not take into account individual differences which exist among the children in all included social groups for social or biological reasons. The study didn't include the aspects of assessment of "normal" or typical development at pre-school age; that is, it didn't test for the previously acquired abilities or knowledge of the participants. At the same time, we have shown that such individual differences, in normal pupils, are no obstacle to further acquisition of intellectual actions in situations of properly organized orientation. It is obvious that, in the case of work with children with diverse types of learning disabilities or retardations in development, a different kind of orientation might need to be provided. Additionally, specific kinds of conceptual orientation should be studied by psychologists, and provided for particular aspects of the learning process at pre-school and school age.

Conclusions

1. The zone of proximal development might be used as a method for assessing the stage of intellectual development, instead of traditional psychometric and quantitative assessment.
2. The inclusion of the zone of proximal development in the practice of assessment may show not only the potentiality or impossibility of the realization of one or another task, but also essential qualitative characteristics of child's performance.
3. Two main aspects may help determine the zone of proximal development: 1) the stage at which a child acts after orientation, and 2) the amount of this orientation given by researcher.
4. Preschool children, in the majority of cases, need complete external orientation, according to the structure of the intellectual task. Such orientation permits them to solve new intellectual problems on a verbal level after orientation has been presented on a materialized level.

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Original manuscript received October 24, 2015

Revised manuscript accepted July 11, 2016

First published online December 01, 2016