Developmental Analysis of Symbolic Perceptual Actions in Preschools

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Authors' contributions

This work was carried out in collaboration between all authors. Author YS designed the study, wrote the protocol and supervised the work. Author CXGM carried out all laboratories work and performed the statistical analysis. Author LQR managed the analyses of the study. Authors YS and CXGM wrote the first draft of the manuscript. Authors YS and LQR managed the literature searches and edited the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The goal of this study is to identify developmental level of symbolic actions at perceptual level. 20 preschool children between 5 and 6 years old from the city of Bogota were included in the study. The level of symbolic development was assessed by application of qualitative protocol designed for this purpose before and after inclusion of the children in the social role-play. The results showed low level of symbolic development before participation on the playing activity. After participation in formative program based on social role-play the children showed positive development of symbolic actions. Such changes were observed by implementation of the same protocol after the program. The results have permitted to propose some indicators of positive symbolic development at

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perceptive level. Among such indicators there are: possibility for generalized representation of features of an object or situation on graphic level; to create a recognizable symbol and to use graphic symbols as means for memory and ability to explain the meaning of own drawings. We discuss the inclusion of external materialized and perceptual means inside social role-play in order to guarantee positive development of symbolic function.

1. INTRODUCTION

According to psychological and developmental research, symbolic function is one of the central aspects of cultural development from early childhood [1,2,3]. Two main points of view on the mechanisms of symbolic development exist. Some authors believe that symbolic function appears spontaneously as a result of both evolutionary mechanisms [2] or of verbal communication with an adult within concrete social situation [1,3]. Other authors, within historical and cultural research and activity theory frames, claim that only biological mechanisms or social interaction may provide spontaneous development by itself [4,5,6]. Leontiev [7] stresses that for appropriate cultural development the child has to become a part of specific type of activity, which would guarantee development of function or action, which is studied. The child has to be not only "participant of the context", but also participant of joint directed activity. During preschool age, such activity should include symbolic means [8].

The goal and purpose of oriented activity is a subject of gradual development. Oriented and guided activity doesn't appear "suddenly" from social context, but might include each particular child. In the case of symbolic development, specific organized and guided activity may help to form symbolic actions on different levels: materialized, perceptual, verbal. Different prominent psychologists have studied the importance of development of symbolic function and it's relation with playing activity in preschool age [9,10,11,12].

From this perspective, it is important to continue the study of formation of symbolic function on perceptual level starting from the level of external materialized actions. Through methodology of formation process [13], it was shown the possibility to follow the path of gradual development of any psychological function or concept [14]. Symbolic function may be also formed as a result of joint activity, which includes symbolic actions as means for formalization of the content of plays [15]. The goal of such process of joint formation would guarantee development of symbolic function from elementary substitution of objects in play up to the level of perceptual representation of imaginary situation [16,17,18]. In the case of formative activity children, even children with low initial level of development of symbolic function might be included in the process of formation. Appropriate activity with organized structure should be chosen for such a purpose. According to the literature, an example of such an activity might be social role-play [9,19,20].

Elementary level of symbolic function might be characterized by actions of external substitution and representation of objects and expressions. Development of symbolic function starts from materialized level, which may be achieved by participation in organized playing activity [15]. Perceptual level might be characterized as a possibility of a child to use means of representation at graphic level. We may say that it would not be just drawing of something of paper, but intentioned of representation of means, signs and symbols with specific meaning in the context of playing with social roles [16,21,22,23,24]. Such ability might be understood as a generalized representation of objects, situations and phenomenon. "Perceptual actions require perceptual recognition of represented elements and understanding of the fact that the images are symbols and might be used by the child and by the others for representation of objects and events, both real and imaginary" [25, p.135]. Simple denomination and reference to objects is not enough to be considered as symbolic function even if the child uses them correctly.

Vygotsky [26, p. 162] has written that "the drawings of little children act as a fixation of gestures and not as a reflection of visual features of the objects. The gesture offers the relation between pictogram and symbolic play". This proposition suggests that the social role-play and

usage of symbols permit to achieve more complex symbolic development. Perceptive level of action appears from the transformation and interiorization of initial material and materialized action [27].

1.1 Statement of Art

At preschool age, the children can achieve more complex level of symbolic development by inclusion in organized activity of plays with social roles. Possibility of positive development of symbolic materialized actions in playing activity was shown in our previous studies. Symbolic materialized actions refer to the usage of an external object as a substitute of another one. Normally such actions appear in plays with objects and toys [2,28,29]. Different symbolic means were used by children in order to regulate rules, to distribute the roles and turns in playing activity with imaginary situations [16,30,31,32].

Symbolic development should not be understood as isolated path of development. It always takes place within significant communication. In order to understand communicative intention, children have to acquire the sense of how and what for the symbol was created and used during meaningful collaboration. In other words, children have to understand why and how the symbol refers to what it represents [33]. Intention within collaboration promotes the access to symbolic comprehension [34,35,36,37]. This kind of comprehension can appear according to usage objects and toys in playing actions. Later on, however, simple external playing actions are not sufficient for progressive development of symbolic function. Children's initial drawing is rather important for psychological development and helps to introduce level of graphic representation and intellectual action on perceptual level. Proper understanding and usage of symbols requires ability for identification of represented objects and differentiation of real objects. Children have to be able to form mental representation of visual material and use visual information for guiding of behavior [38]. Our own previous studies have shown positive results of the work with identification of features of external objects, comparison and differentiation of essential features as the necessary step for gradual formation of drawing activity at preschool age [39,40].

At the same time, the drawing activity by itself it is not enough to continue with development of

intention for elaboration and application of symbolic means directed to one another. Little children may have reasonable difficulties in understanding of relation between symbol and the content of representation; double objective of representation of real objects with all features and symbolic meaning of situations is rather difficult [41,42,43]. On the contrary, inclusion of symbolic means, starting from materialized level, in the social role-play helps children to achieve the meaning of symbolization. Gradually, symbolic means may pass from materialized level to the level of perceptual representation of rules, norms of behavior and other aspects, which may help for formalization of the structure of plays. "Representation of images is the product of determined perceptive actions. The image cannot be formed without appropriate action" [44, p. 33]. We agree with this position and believe that inclusion of symbolic perceptual means, as a structural element of social role-play might be one of the ways for gradual formation of complex symbolic activity.

The purpose of this study was to show possibility of progressive development of symbolic function by participation in formative process of playing activity. The playing activity with inclusion of elementary and complex symbolic means was created with this purpose. Qualitative assessment of the level of consolidation of symbolic actions was applied in a group of preschool children before and after participation in playing activity with social roles.

2. METHODS

The study was based carried out on the basis of the process of formation within joint activity as the main methodology of Vygotsky's psychological school and activity theory [13,45]. After assessment of initial level of symbolic function of perceptual level, all participants were included in original program of playing collective activity with social roles and symbolic means. After participation in the formative process, final assessment was applied in order to establish any positive changes in the level and complexity of symbolic function formation in participants. The questions of our research were: 1) to verify the effectiveness of the program of playing activity for formation of symbolic perceptive actions and 2) to show the useful methodology for development of symbolic function at the end preschool age.

2.1 Participants

20 preschool Colombian children aged from 5 and 6 years from the city of Bogota were participants of the study. Public preschool institution in suburban area of the capital was selected for the study. Educational level of children's parents was low, as well as living social conditions. The preschool institution was of vulnerable economic and social life conditions. Vulnerable conditions refer to extreme poverty, low levels of primary education of children's parents. The Table 1 shows social features of participants, the Table 2 shows educational level of mothers and fathers of the children and Table 3 presents types of occupational of the children's parents.

Table 1. Characteristics of the participants

Genders		Average age
Girls	Boys	
9	11	5.1

Table 2. Educational level of children's parents

Level of education	Mothers	Fathers
Primary school	8	9
Unfihished secondary level	9	8
Secondary level	3	3

Table 3. Ocupation of parents

Ocupation	Mothers	Fathers
Housewife	14	0
Domestic servant	4	0
Worker of small establishments	2	6
Peddler	0	4
Driver	0	7
Construction worker	0	3

The educational method of chosen institution was of traditional style and consisted of purely reproductive tasks. Cognitive tasks consisted on were based on behaviorism habits of repetition of rules or reproduction of elementary tasks of copying of letters, words and numbers. Playing activity was reduced to individual manipulation with limited number of toys and classification of objects by one perceptive feature. Playing in groups was only part of recreation periods and never as guided actions in classroom. Children had no experience in collective kinds of organized games, neither of drawing or games with social roles.

2.2 Instrument of Qualitative Assessment

Special interactive instrument for assessment of development of symbolic perceptive function was used before and after inclusion of children in program of playing activity. The scheme of assessment includes the tasks for symbolic representation of imaginary situations in graphic level [46]. The Table 4 shows the structure of scheme and the content of the tasks. All tasks are provided within joint interaction between adult and child.

During the study the ability of children to fulfill the tasks was assessed firstly without external help of the adult. If the child was not able to fulfill the task, the adult started to take part in the process and helped to fulfill the task, so that the ability of a child to fulfill the task after helping was also tested. Following types of external help proposed by the adult during assessment were used in the study: 1) emotional support during fulfillment; 2) repetition of the instruction; 3) joint dialogue between adult and child about the content of the task; 4) giving examples of symbolic representation.

2.3 Procedure

Permission of the institution and agreement of parents were obtained before starting with assessment. Assessment was accomplished individually with each child in one session of 30 minutes approximately. After initial assessment, the children were included in the original program of playing activity. The activity took place in school time, 4 times per week during 8 months with the total of 240 hour of work. All activities were collective and included all children. Results of initial and final assessments were compared after finalization of the process of formation with the same group of children. Results were scored according to the fulfillment in the zone of actual development (individual fulfillment of the tasks without any external help), in the zone of proximate development (fulfillment of the tasks after provided help of the adult) or total impossibility of fulfillment (even after proposed external help).

Table 4. Structure of the scheme and the content of the tasks for assessment of symbolic perceptual development

Tasks and instructions	Description
1) Pictograms. "Draw a picture, which corresponds to the word, which I say"	*The child is given a paper and a pencil and is asked to draw the pictures, which correspond to the following words. The words used in this task are: angry teacher, joyfully holiday, strength, letter for your mother saying what you would like to eat on Sunday). The child is asked only to draw (no to write). The adult may help with different explanations and questions about "an angry teacher".
2) Drawing of the path. "Draw a path from your house to the nearest shop"	*The child is given a paper and a pencil and is asked to draw the path (the road) from the house to the shop. The adult may help asking if the child knows any shop close to the house or can imagine the house with the nearest shop.
3) Drawing of the signs. "Draw the places in the town"	*The child is given a paper and a pencil and is asked to draw the places of the town, which he or she knows. The adult may help using examples and asking, which places does the child knows or remembers of the town. The adult may help asking if the child knows or imagines the house and the nearest shop.
4) Drawing of the traffic signs. "Draw a traffic sign to indicate that the cars may not pass through"	*The child is given a paper and a pencil and is asked to draw the sign of traffic, which shows that the cars may not pass through the street. The adult may help asking if the child knows how the cars can move in the streets and when some works or reparations are done, the cars may not pass. How we can let them know?

2.4 Program of Playing Activity with Social Roles

It is important to stress that formative activity normally is applied to groups of participants, for those proposed activity is new [16,17,19,29]. In our case, the children had no possibility to take part in collective plays with content of social roles in the context of their day-to-day life. That means that this kind of activity was introduced and forms gradually within the classroom while working with the program. Formative playing activity proposed in the program implicated realization of communicative representation of imaginary social situations. Each situation included typical roles (characters), which were presented and explained to the children firstly. Examples of such situations were: hospital, airport, restaurant, pharmacy, veterinary clinic, hair esthetic, photographers, theatre, street traffic, clinic toys, safari, painters of colors elephant, paleontologists, dinosaurs and flower dreamy and so on. The content of each play included the following elements: roles, verbal actions, representative verbal actions with objects and symbols. The elements was explained, discussed and represented to the children before starting to play. The symbols were created together with the children in order to represent signs, which were to follow during the playing procedure. Symbols were created also for determination of roles and order in specific actions during the play. The Table 5 represents examples of the content of narrative role-play.
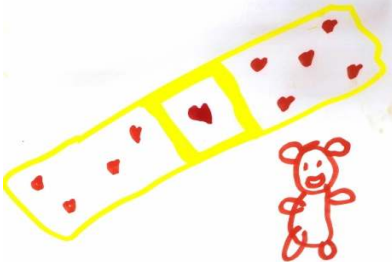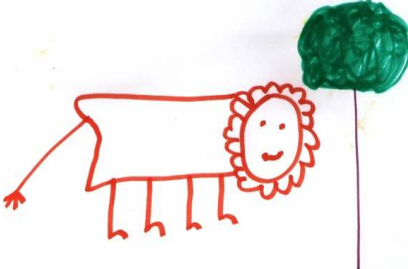
The program included 5 levels of complicity according to formative stages of social role-play activity. The first level referred to constant usage of external objects and toys and external attributes of the roles. The second level referred to more expanded and profound realization of social communicative actions by children. The third level permitted to pass to independent creation of symbolic means. The forth level shows high initiative for determination of all elements of the content of plays. The last fifth level permitted to start narrative creation of new imaginary situation according to the initiative of the children. The Table 6 shows examples of elaboration and usage of symbolic means at each level of social role-play activity.
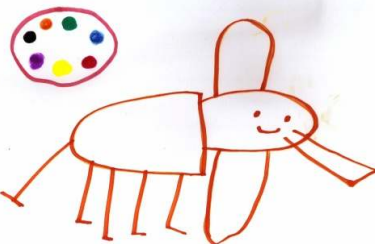
As the Table 6 shows, symbolic means were used from the very beginning, but the level of complexity and initiative of children increased at each following stage of the program.

Table 5. Content of narrative role-play "Dinosaurs, dreamy flowers and the treasure"

Content	Description
Actions	*The children have choose the topic of the play and decided that the object of the exploration were the treasure in the magic jungles of the dreams. The jungle was full of the boys-dinosaurs and girls-flowers. The explorers have created the map for searching of the hidden treasure. Different fantastic creatures were hiding the treasure and made a lot of obstacles. In order to find the treasure it was necessary to follow the sings in the route and study the map carefully and overcome all the obstacles. Finally, the treasure was found and a great celebration organized. The duration of the play was 2 hours.
Roles	*The children have chosen the characters of the play by their own initiative: dinosaurs (3 boys), flowers (3 girls), little magic creature (1 boy), king (1 boy), and explorers (12 children and 1 adult).
Verbal actions	*Different verbal expressions of the children according to the characters, such as: "I am the king of this jungle", "we have to look in the map and find the treasure", "let us help the flowers" and so on.
Action of representations	*Different means of representations by postures, gestures and facial expressions were used during the play in order to represent imaginary actions and situations.
Symbolic means	*Symbols for roles: specific symbols were created for personalized representation of each character. *Symbols for rules of the play: red triangles as sing to follow the path in the map, marks in the map and circle as sing for being silent not to be noticed by king and so on. *Some of the symbols were prepared collectively and the others were created individually by some of the participant. *The children created the map for finding the treasure.

Table 6. Examples of elaborated symbolic means

Stages	Symbolic means created by children	Indicators of positive symbolic development
1. Social role-play with predominant usage of concrete objects	 Role-play "Clinic foro toys"	*The symbol reflects the content of expression (topic). *The symbol may be recognized by the child who produced the drawing and also by the other participants. *The child is able to explain the symbol.
2. Social role-play with usage of substituted objects	 Role-play "Safari"	*The child may generalize the features of the represented situation. *The child may choose the symbols for the topic. *The symbols might be used during the play procedure.

Stages	Symbolic means created by children	Indicators of positive symbolic development
3. Social role-play with objects and substitutes of objects in various types of situations	 Role-play "Painters of the colors"	*The meaning of the sign proposed by the child might be understood and used within the play by all participants.
4. Social role-play with increasing initiative of the children for all elements of the play	 Role-play "Paleontologists"	*The symbol represents a strategy for mediation of remembering of the rules and situations. *The child may explain the symbol by used expressive features and the precise meaning for the play procedure.
5. Narrative role-play	 Role-play"Dinosaurs, flowersdreamy and the treasure"	*The child proposes all symbols independently. *The symbols are used during problem solution within the content of the plays. *The map for actions might be created by the children.

3. RESULTS

The responses of the children (execution of the tasks of qualitative assessment) were evaluated with following scores: 1 –answer without external help (task in the zone of actual development); 2 – answer with external help (task in the zone of proximate development) and 3 – difficulties answer even after external help (impossibility to fulfill the task). In order to characterize types of children's responses during participation in the tasks, all responses were classified and generalized according to the scores.

Table 7 shows the percentage of children who fulfilled the task independently, with the help of the adult and children who were not able to fulfill the task before and after participation in the program.

The Table 8 shows concrete examples of fulfillment of the tasks before and after participation in the program.

Statistic analysis of the results of initial and final assessment pointed out significant difference favorable to the final assessment. The Table 9 shows results of statistical analysis. The results of the analysis show that more children were able to fulfill the tasks of the assessment independently after participation in the program. Important progress was found in relation to the fulfillment of all the tasks during final assessment.

Table 7. Percentage of children's responses before and after participation in the program

Task	Pre-test			Post-test		
	Score 1	Score 2	Score 3	Score 1	Score 2	Score 3
Drawing pictograms and letter	0%	10% (2 children)	90% (18 children)	100% (20 children)	0%	0%
Drawing of the path (route) from the house to the nearest shop	0%	10% (2 children)	90% (18 children)	100% (20 children)	0%	0%
Drawing of the signs for places in the town	0%	10% (2 children)	90% (18 children)	90% (18 children)	10% (2 children)	0%
Drawing of traffic signs	0%	5% (1 children)	95% (19 children)	90% (18 children)	10% (2 children)	0%

Table 8. Examples of execution before and after participation in the program of playing activity
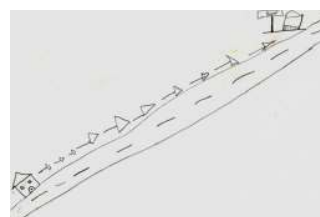
Before program	After program
Taskpictograms (Girl KG)	(a) (b) (c) (d) Taskpictograms (Girl KG)
* The girl cannot explain her drawings and cannot remember what she drew. *The image does not reflect the requested content. *The picture is not recognizable.	a. "Let's say the teacher is very angry and has the angry face. The teacher is upset because her children do not know the colors ". b. "This is the joyful birthday party of my brother. He has many balloons, the cake and many ice creams. All guests are happy!". c. "This is a man with muscles showing that he is very strong". d. "This is the letter to my mother where I say that on Sunday I want to eat pasta, pineapple juice and candy". *The image produced by the child reflects the content of the words (pictograms) and the content of the letter. *Selection of a common symbol for expression of the content is adequate. *The girl can explain what was drawn and why. *The girl can remember what was drawn and why.
The way from the house to the nearest store (Girl KG)	The way from the house to the nearest store (Girl KG)

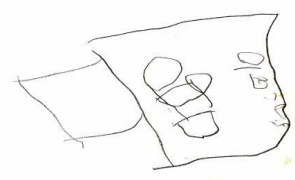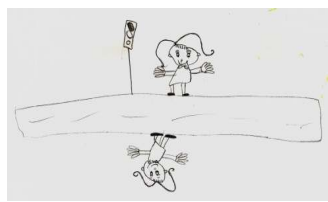|	
* The girl cannot explain her drawings and cannot remember what she drew. *The image does not reflect the requested content. *The picture is not recognizable.	"Let's say my house is down here and the shop is up there. Then we have to go to the shop, we have to climb this way". *Drawing reflects the "route from the house to the shop". *The girl can explain what was drawn and why. *The girl can remember what was drawn and why.
 Places of the city (Girl KG)	 Places of the city (Girl KG)
* The girl cannot explain her drawings and cannot remember what she drew. *The image does not reflect the requested content. *The picture is not recognizable.	"Let's here's a candy store and here is the baby store, here is a house, there is a building built by the builders here, here's a bakery, here's a fruit. I also drew the symbols for people to see what is there in the city that I drew". *Drawing reflects "places in the city" *Selection of a common symbol for expression of places in the park is correct. *The girl can explain what was drawn and why. *The girl can remember what was drawn and why.
 Sign indicating not to pass (Girl KG)	 Sign indicating not to pass (Girl KG)
*The girl cannot explain her drawings and cannot remember what she drew. *The image does not reflect the requested content. *The picture is not recognizable.	"Say you are here in red, yellow and green. Green is when the cars pass and I do not pass because it's dangerous and I stay very still. After the traffic light changes color and turns red, and that if I pass the street to the other side". *Drawing reflects the traffic signs. *Selection of a common symbol for expression of traffic signs is correct. *The girl can explain what was drawn and why. *The girl can remember what was drawn and why.

Table 9. Statistical analysis of results of initial and final assessment

Task	Z	p
Drawing pictograms and letter	-4.0	0.00**
Drawing the route from home to the shop	-4.0	0.00**
Drawing signs for places in the town	-3.87	0.00**
Drawing traffic signs	-3.87	0.00**

**Significant at 1%

4. DISCUSSION

According to Vigotsky's theory of historic and cultural development [3], which is a theoretical background of our research, the real determination of indicators of symbolic function is their fulfillment in the zone of proximate development. In other words, it is ability of children for realization of symbolic action within joint activity with an adult and the other children. The zone proximate development refers to the possibility of participation in proper realization of an action in guided situations; later on the child acquires ability of independent fulfillment of the actions [47,48]. The zone of proximate development is a form of special interaction of the joint action of the child and the adult and is directed to generalize and to support the initiative of the child [49].

The results of our study demonstrates that the playing activity based on participation in plays with social roles seems to be ideal methodology, which might guarantee progressive development of symbolic function and help children to achieve more complex perceptual level. Important progress was observed during fulfillment of all tasks of the protocol. Similar results, but in the other levels were obtained in the previous studies. Important progress in symbolic development was shown through analysis of symbolic substitutions at materialized level [15]. Other studies pointed out positive changes in the possibility to make own reflection during participation in playing activity [50,51,52]. Positive development of voluntary actions were achieved also in groups of Mexican children in conditions of public institution for children without parents [53] and in groups of preschool children in kinder gardens in Mexico [54] and Colombia [4].

Analysis of results of initial and final assessment has pointed out important developmental changes in symbolic development of participants. The responses of the children in initial assessment show that none of the children was able to fulfill the task independently. Only 10% of children were able to fulfill the task with help of the adult. After participation in formative program, 90% of children fulfilled the task independently and 10% fulfilled it with the help of the adult. 10% of children passed from the zone of proximal development to the zone of actual development. At the same time, the results show that 90% of children passed from the level of total impossibility to the level of the zone of proximate development.

In general, it is possible to observe that the responses of initial assessment were chaotic and frequently it was not possible to find any kind of relation with the purpose of the task. The lines of the drawings were totally disorganized, it was impossible to recognize objects, features or situations. Luck of proportions, absence of general forms and spatial relations between perceptive elements were typical during initial assessment. Such data agreed with our previous study, in which level of development of symbolic perceptive actions were assessed in a population of Mexican preschool children [55]. There were no essential features of the objects represented in drawings; the drawings didn't correspond to the purpose of the tasks and were not recognizable at all. The results of this study showed similar data as poor level of spontaneous development of symbolic actions. It is interesting to stress that spontaneous development is not enough for proper level of symbolic development and seems not to be related to particular culture, as similar data were obtained in Colombia and Mexico.

Positive differential features appeared in the executions during the final assessment. The examples of children's executions show important improvement of means of representation during final assessment. In tasks of final assessment, as our examples show, it is possible to observe features of represented objects, the drawings became related to the purpose of the tasks, spatial relations are much more determined and in general it is possible to recognize children's graphic representations. We may suppose that it was possible to create internal perception of situations starting from external gesture of children and by using means of representations [3,26,56]. It is important to stress that such means of representations were discussed and created not individually by each child, but as a result of joint collective activity. Social role-play was not "free" and not of spontaneous kind, but included all elements of orientated activity. The goal of such activity was representation of social roles in imaginary complex situation. Such opportunity for development of symbolic representations is very poor in traditional conditions of preschool education in Latin America. That is why the whole activity proposed in experimental program was based in mutual communicative and affective expressions by verbal and external (corporal, facial, postures and gestures) means with the usage of objects and symbols. Our previous studies showed positive effects of social

role-play on psychological development of children both in Mexico and Colombia [16,17,29,30,31]. Such effects support other creative proposals for preschool education, which take into account importance of creative communication [57] and symbolic development in drawings creative communication [58]. We are convinced that constant innovation based on psychological and pedagogical research at preschool age is required. Results of research should be included in design of common programs of preschool development in order to improve methods of development and education.

5. CONCLUSION

Obtained data permits to make an important reflection in relation to method for assessment of psychological development commonly used in preschool institutions. We stress that the level of development of symbolic activity depends not on social conditions, but on participation in specific organized guided activity between children with specific communicational purposes. The social role-play might be considered as one of the paths for such development. The content of plays and inclusion of possibility for creation and usage of symbolic representation is a powerful strategy for positive development of preschool children. Our findings might be useful for reconsideration of traditional methods used in preschool institutions in Latin America and new positive revalidation of the meaning of social role-play for preschool age within the theory of cultural and historical development.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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