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The influence of Luria's work on the use of visual modeling in preschool education

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Abstract

This article is devoted to the development of Luria's research on the use of visual models in preschool education. Visual models were considered by Luria as a tool for psychological development within the context of Vygotsky. We present the transformation of this idea and its practical implementation in preschool education. Special attention is given to the "Development" educational program and diagnostic tools that assess visual modeling ability in preschool children. **Keywords:** visual modeling, building by model, cultural tool.

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Introduction

The use of visual models to achieve dual representation by young preschool children interests many of today's researchers. Among the greatest contributions to the field of developmental psychology were the works of Soviet psychologists who studied the purposeful development of children's mental abilities.

The studies of L.F. Obukhova, performed under the scientific guidance of P.Y. Galperin, proved the possibility of overcoming cognitive centration in preschool children. Obukhova hypothesized that "with the help of measures and symbols, labeling them children can learn to determine parameters of objects according to certain pre-set criteria and then obtain principle of conservation in the tasks of Piaget" (Obukhova, 1972, p. 43). Basically, these studies used models that represented original situations with uniform symbols, which allowed the successful comparison of different quantities. Visual modeling became a psychological tool that helped children arrive at the correct answer.

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The problem of model research was also presented as a problem of the dual representation of reality. DeLoache (Uttal, Schreiber, & DeLoache, 1995; DeLoache, 2002) focused her research on symbolic understanding in children's use of models. Her original experiment was conducted with young children who were required to retrieve in an actual room a larger version of a miniature copy of an object that was placed in the same location inside a smaller three-dimensional model of the room. The experiment revealed that 3-year-old children consistently performed well, whereas 2 1/2 year-olds performed very poorly. DeLoache concluded that the successful completion of the experimental task required dual representation. She considers such models as tools for retaining both plans of reality and plans of a model. Alexander Luria studied the use of models in preschool children as early as the 1940s.

Models as tools

Luria considered educational games a prerequisite for the development of mental functions. Construction sets were especially interesting to him (Luria, 1995/1948), which he divided into two categories: ones in which children had to build certain construction sets based on models with step-by-step instructions and ones that allowed the construction of various things (i.e., free play). Both categories of construction activity, according to Luria, had their drawbacks. In the first case, the children became bored following strict step-by-step instructions. By analyzing the smallest details of the construction set, they lost motivation

because they lacked an ability to see the big picture. In contrast, construction freedom in the second category of construction activity allowed children to focus on their own vision of the object they were making, subsequently substituting important constructional elements with their own arbitrary interpretations, which did not bring them to solve real-life tasks that require consideration and the proper use of the chosen building components. In this case, the holistic picture of the finished construction was being substituted by the child's own creative vision of its purpose and meaning, thus making the child reluctant to analyze its elements in detail.

Luria proposed his own psychologically adequate concept of construction play based on the recreation of certain types of models, a task that requires a child to solve specific construction objectives that would orient him toward a search for the solution. This method, called "building by model," required children to reproduce the given preassembled exemplary model using the available construction elements (Figure 1). There was no direct correspondence between the exemplary model and the source construction elements. To complete the task and reproduce the model, the child had to reflect on the actions of the construction elements, think them through, determine their proper sequence, and choose the correct construction elements and their combinations to complete the task.

When interacting with the exemplary model, children perform several tasks. First, the child analyzes it to determine its constituent elements. Because the elements are not easily grasped, the child must single them out and decide on their function according to his own understanding. Without these preliminary operations, the subsequent recreation of the model is not possible. Second, the child must analyze the available construction elements and relate them to the parts of the exemplary model. However, the most important action is that the child needs to change the preliminary analysis of the model to relate the available construction elements to the elements of the model for the subsequent recreation. This last action made this kind of modeling a special tool for developing a child's cognitive functions. Although Luria did not state this directly, the entire design of this method supports this conclusion.

The building-by-model method was experimentally tested in homozygous twins who were divided into two groups. Every day for 2.5 months, the children in both groups played with construction toys. The children in the control group played with ordinary step-by-step construction sets, and their twin siblings in the experimental group built by models.

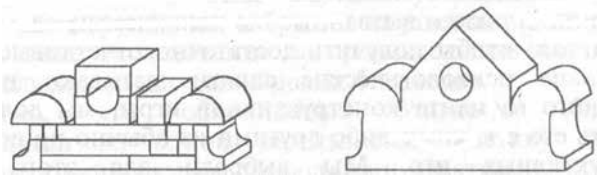

Figure 1. Building by model. (Left) Construction. (Right) Model.

The design of this experiment essentially used the Vygotskian cultural-historic approach. The development of the mind, according to Vygotsky, is well known to be a process that is conditioned by interactions between children and grown-ups that allow forms of psychological activity that are historically developed and culturally stored within society to be assimilated by the child. Children do not merely socialize and adjust to social situations; they also acquire cultural tools that transform their mind. Vygotsky emphasized that psychological development "comes down to the replacement of the tools being used for a task, to the inclusion of previously un-engaged psychological systems, and to the respective rearrangement of the psychological process" (Vygotsky, 1984, p. 77).

The experiment yielded significantly different results between the two groups. The children in the experimental group performed very well, and their actions were significantly more voluntary: "before getting to re-construct the exemplary model children first examined it attentively, built test structures, and only after that were beginning to solve the task" (Luria, 1995, p. 55). Again, according to Vygotsky, voluntariness signifies the successful assimilation of a cultural tool. The children in the control group were "fast to start the task, without hesitation they were taking construction blocks and built with them" (Luria, 1995/1948, p. 55).

The use of this type of modeling influenced the children's performance in other tasks, proving that it is a cultural tool for psychological activity. For example, in their drawings, the children in the experimental group were more attentive to the object's structure. They performed better on mental transformations and could voluntarily discern complex structures on a uniform background. In this regard, the studies performed by Luria that used a cultural-historical approach were the first works to view modeling and the use of models as special tools for preschooler's psychological activity.

Development of Luria's ideas in the 1970s

The use of visual models in preschool education was studied and furthered by scientists at the Preschool Education Research Institute, Academy of Pedagogical Sciences, USSR. Within the paradigm of human nature shaped by the works of Vygotsky, Leontiev, Luria, Rubinstein, Zaporozhets, Elkonin, and other researchers, children's operations with visual models were viewed within the context of cognitive abilities, bringing scientists to the conclusion that preschool children have visual modeling ability. Zaporozhets was the first to propose the concept of sensory standards as special symbolic tools that are responsible for the development of higher mental functions in preschool children. He maintained the Vygotskian cultural-historical approach and thus opposed culturally conditioned, mediated psychological development to naturalistic views of the child's nature. He insisted that children's development in preschool years should not be accelerated but rather amplified, meaning

that children's development during this period of their lives should be saturated by age-specific activities. This standpoint forced Zaporozhets to look for manifestations of visual modeling ability in various types of children's activities, which he found in pretend play, drawing, and constructing (Zaporozhets, 1972).

Zaporozhets noticed that these types of activities were essentially modeling. In pretend play, children modeled the social interactions of grownups. In drawing, children reproduced the spatial properties of objects rather than simply copied them. In constructing, preschoolers recreated complex systems of relations by building miniature models of real-life objects. The modeling character of these types of children's activities led Zaporozhets to conclude that the processes of visual modeling are incorporated in forms of activities that are specific to preschool children, are not random, and need to be studied purposefully to determine their role in children's development.

Venger, a student of Zaporozhets, hypothesized that these facts signify the development of the visual modeling ability that is specific to preschool children. He believed that this ability ensures the mastery of various types of activity and also the overall cognitive development of a child. Studies of visual modeling ability and its purposeful development became an important direction of the work in the Laboratory of Psychology headed by Venger (Zaporozhets, Venger, Zinchenko, & Ruzskaya, 1967).

Venger began by studying tools that characterize visual modeling ability as a specific, distinct ability. Following Zaporozhets, he proposed regarding visual models as such tools. Notably, visual models as cognitive tools were studied not only by Luria at that time. Galperin (1969) and Davydov (1972) also studied their use in school-age children. Therefore, the notion of visual modeling advanced from the works of Luria to their understanding as a special cognitive tool in preschool children, allowing one to trace its development from kindergarten to school.

Venger put forward a hypothesis that visual modeling ability can be developed by mastering certain operations with visual models such as substitution, construction (i.e., the recreation of interrelations between the elements of real-life objects through interrelations between the elements of their models), and the use of models to solve tasks (i.e., the purposeful analysis of a model).

Venger endowed children's notions of spatial relations with model properties in which such relations were present in the form of schemes or plans. In experimental studies, children acquired visual modeling ability by learning to build graphic plans and use them to visually orient them in real-life environments. The ability itself was viewed as orienting activity, based on creating a special tool (i.e., a graphic plan) and using it to guide specific actions (i.e., building a plan and orienting by planning).

Development of the ability to model by Vengerom and colleagues was presented in an educational program for preschool children (3-7 years old) called "Development." It included a variety of topics, the key areas of which were related to orientation in space and constructing. In the section dedicated to the development of orientation in space, the children acted with models that changed in scale and structure. The complexity of its tasks and scope gradually increased throughout its duration. First, in terms of scale, step-by-step transitions were made from a scale model of a classroom to the actual room, from the actual room to the kindergarten building, from the kindergarten building to the kindergarten territory, and then to the space of the entire city. Second, in terms of structure, the teachers gradually increased the number of objects in a model from a few pieces of simple furniture to spaces filled with various different items. Third, in terms of actions, new forms of operations with models were gradually introduced. After the children learned to build graphic plans and orient by them, they were given new assignments such as reproducing plans from memory or working with a coordinate system introduced into the plans.

The program began by making children familiar with a scale model of a room furnished with a small amount of simple furniture that varied in size and shape. The basic set of furniture included a round table, rectangular sofa, and square armchair. Each child was given a sheet of paper that resembled the scale of the room and a set of simple-shaped flat cards (a circle, a rectangle, and a square). The child was asked which of the cards resembled which piece of model furniture and then was instructed to place them on the piece of paper in the same arrangement as in the model room. A variation of this assignment included a doll that "needed children's help" in arranging furniture in a model room and then needed its plan. All of the children at the end of their fourth year of age were able to build a scale model of a room with regard to the spatial relations between its objects.

The next stage of the program, beginning when children were 5 years of age, was dedicated to teaching the children to orient according to plans. Two major types of practical tasks included the alteration of a model in accordance with a plan and orientation by a plan in a real-life environment.

For tasks of the first type, a scale room model with randomly arranged furniture was used. The children were told that a doll wants to rearrange furniture in her room in accordance with a plan she drew and asked for help to do that.

The tasks of the second type were orienting in a scale model room according to a graphic plan. The furniture in the model room was prearranged in strict accordance with the one in the plan. A small object was then hidden in a model room, and its location was marked in a plan. The children were supposed to find that small object in the model room, guided by the plan as a map. A variation of this assignment included a doll that needed to be placed in the exact same place in a model room as the one marked in a plan.

Because these tasks were getting increasingly more complex, they were transferred from the environment of a model room to a real-life classroom where the children studied. Based on this, the number of unique and same objects in the room also increased (e.g., the number of tables). Rearranging the furniture and likewise transforming the classrooms diversified their look and purpose, which attracted the children to participate in the process. By the end of their fifth year of age, they were able to successfully cope with these tasks, including ones that required operations with metric relations.

Special attention was given to the development of construction using visual models. It included the following tasks: "creating buildings by the wholesome graphic plan using the available construction material; describing objects using basic geometrical terms (lines, shapes); the use of schemes as exemplary constructions; building a disjoined scheme of an object; building a construction of own design by previously drafted plan was; completion of unfinished constructions with the use of schemes" (Venger & Diachenko, 1996, p. 23).

Together with R.I. Govorova, T.V. Lavremtieva, and O.M. Diachenko, a special method for diagnosing operations with visual models among preschool children was elaborated by Venger (Venger & Kholmovskaya, 1978). The test material comprised a textbook that consisted of 12 pages that showed lawns with multiple paths and houses at the ends (Figure 2). The bottom of each page shows a map with a path to one of the houses. The child's task is to properly mark the house to which the map leads. More than 1,000 children of preschool age participated in method elaboration. This method became well known not only in Russia (where all preschool psychologists and many thousands of children are familiar with it) but also abroad. It is part of the set of diagnostic methods known as A Developmental Neuropsychological Assessment (NEPSY-II; Korkman, Kirk, & Kemp, 2007). Unfortunately, the authors of the NEPSY made no reference to the research made by Venger and his group, although they refer to Luria, demonstrating the common line of research conducted for more than 50 years.

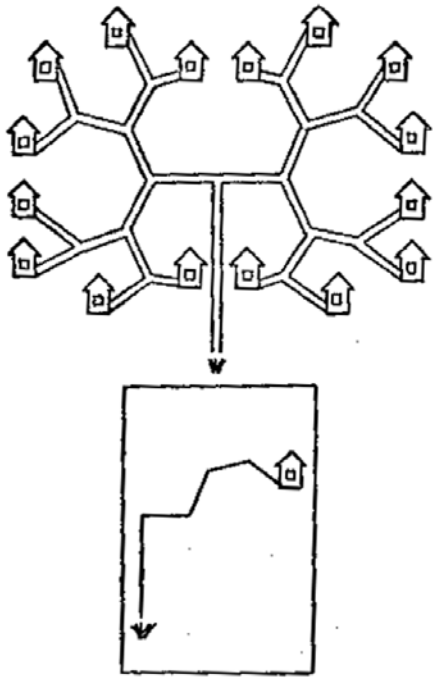

Figure 2. Example of "schematization"-method tasks (Source: Venger & Diachenko, 1996, reprinted with permission).

Conclusion

In the present article we presented the development of Luria's idea, devoted to the role of tools in children's cognitive development. Luria showed the relationship between successful construction by children of preschool age and the types of models used by children. He was actually the first in the 1940s to inspect the possibilities of visual model usage in the psychological dimension, although he did not use the concept of "model" itself. Luria stressed the generality of the visual tool. Visual models were used as effective tools of cognitive development by many famous Russian psychologists including Galperin, Zaporozhets, Leontiev, and others. This became possible because these scientists were also followers of Vygotsky, and the idea of a mental tool was used by them extensively. For example, Zaporozhets talked about the modeling nature of children's activity. Venger, a follower of Zaporozhets, investigated the possibility of using schematic drawings as tools for cognitive development and discussed the ability of visual modeling as one of the key features of preschool age. Thus, Luria's idea about the possibility of using visual schemes transformed into the idea of visual modeling ability and visual model usage for various cognitive tasks.

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