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**RELATIONSHIP BETWEEN QUALITY OF ENVIRONMENT AND
COGNITIVE DEVELOPMENT IN PRESCHOOL AGE**

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Abstract

The article presents the results of a study aimed to analyze the relationship between the mental development of older preschool age children and the quality of the literacy environment in which they are immersed. The study involved 250 children from 8 kindergarten groups. To obtain a more detailed analysis and comparison of the children's mental development parameters, two most contrasting groups were chosen. The study found that the indicators of mental development of the emotional and personal and cognitive spheres are higher in kindergarten children with higher indicators of literacy environment quality, especially regarding the specific features of child-adult communication and the conditions necessary for children to develop their reasoning skills in the process of communication. This study concludes that the research outcomes reflect important features of the mental development process in children included in this or that literacy environment. The study results can serve as a basis for further elaboration of recommendations on how to organize an environment in a pre-school educational institution.

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Keywords: Preschool age, quality of the educational environment, mental development, executive functions, intellect, theory of mind.



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1. Introduction

One major aspect of fast-developing modern research in Russian psychology and pedagogy is related to assessment of literacy environment quality in pre-school educational institutions (Perlman et al, 2004; Pons et al, 2000). Interest in this area derives from the need to study and identify the most significant factors in preschool education that affect children's mental development (Harms et al., 1998; Korkman et al, 2007).

According to the cultural and historical approach, the source of the child's mental development is to be found in communicating with significant adults by assimilating their cultural standards of reasoning and activity (Sobkin et al, 2016).

Throughout the preschool childhood years, profound qualitative changes and transformations take place in the child's mind and activities. Thus mental functions become mediated and voluntary. A preschooler gradually overcomes self-centered thinking so typical of him at the previous stages of his development (Almazova et al, 2016; Frye Zelazo & Palfai, 1995; Happé, 1994; Mayer, 2001; Taylor, 1996).

Key to the implementation of these changes and successful mental development are the specific features of the child's relationship with the adult and the social reality that surrounds the former. In his relations with the child the adult acts as a representative and a direct bearer of social requirements, norms and social implications.

2. Problem Statement

Thus research into the role of a literacy environment in pre-school organizations is fundamentally importance for identifying the most significant factors that affect mental development in preschool childhood. Understanding the significance of various factors of the literacy environment will allow us to organize the process of education and training in the most effective way and to create conditions for children's personal development.

3. Research Questions

In the study, we proceeded from the assumption that mental development indicators of the emotional-personal and cognitive sphere are higher in kindergarten group children with higher indicators of literacy environment quality in terms of the specifics of child-adult communication and conditions for children's development of reasoning skills in the process of communication.

4. Purpose of the Study

The purpose of this study is to examine the relationship between the quality of the literacy environment and the characteristics of the mental development in older preschool children in order to find the most significant determinants of their development.

5. Research Methods

In order to collect data on literacy environment quality in a kindergarten, the Early Childhood Environment Rating Scales (ECERS-R) were applied (Harms et al, 1998). The use of this instrument in scientific research for more than 35 years has confirmed the validity, reliability and accuracy of the results obtained with its help.

The revised ECERS operate on the principle of raters' observation. Depending on the conditions represented in the environment, a rater decides to assign scores on this or that item according to a number of indicators. Objective assessment of literacy environment conditions is ensured by an evaluation sheet the rater has which includes specific, observable and measurable environmental conditions (Indicators). The maximum score that can be assigned to each of the indicators is 7, the minimum score is 1.

Let us consider the methodological set of tools used to assess preschoolers' mental development. Many of the following methods are Russian-language versions of the NEPSY-II subtests (Korkman et al, 2007).

Methods aimed to diagnose the development level of the child's social intelligence and his emotional-personal sphere:

- In order to diagnose ToM development we used the NEPSY-II subtest - Theory of Mind. This subtest shows how well developed a child's representations of another person's thoughts and feelings are.
- To assess the child's ability to understand other people's emotions and feelings in different situations, the Emotional Comprehension Test was applied (Pons & Harris, 2000). The tasks in this technique are stories with illustrations, depicting events that occurred in the characters' lives. After the child is told each story, he is asked to define the characters' experiences.

Methods aiming to measure cognitive development:

- Raven's Color progressive matrices (Raven et al, 1998) measure non-verbal intelligence.
- Memory for Designs (NEPSY-II) measures two aspects of visual memory - memory for "images" (choosing cards from a set of similar pictures as in the sample presented) and spatial representation (choosing the place where the cards were placed in the sample).
- Sentences Repetition (NEPSY-II) reveals the development level of the child's verbal memory. The method comprises 17 sentences, which are in turn read out to a child for him to repeat after the experimenter.

Methods for measuring the level of voluntariness of behavior and cognitive processes:

- Inhibition (NEPSY-II) consists of two samples: the first one is the naming of geometric figures, and the second is inhibition (naming of geometric figures in the reverse order). The results of the child's performance on this technique (the number of errors made and the time spent on each of the samples) allow us to determine the development level of switching and constraining processes.
- Dimensional Change Card Sort (DCCS) (Zelazo, 2006) measures the cognitive flexibility of mental processes. The test consists of three samples: in the first a child is asked to arrange the cards offered to him by color (PreSwitch). In the second – to arrange them by shape (PostSwitch). And in the third the child is asked to sort the cards according to their color or

shape depending on the presence of an additional feature on the card (the presence of a black border).

6. Findings

6.1. Comparison and analysis of the results assessing literacy environment quality

Examination of the literacy environment quality of two kindergarten groups by using the ECERS-R scales, allowed us to obtain the mean values for each of the areas assessed (Table 01).

The table presents scores for each of the areas of literacy environment assessment. The values are obtained by calculating the arithmetic mean of the total scores assigned by the indicators included in the area assessed.

According to the ECERS-R guidelines, substantially significant differences in subscale scores should be considered a variation in values greater than or equal to 1. Thus, when comparing the results of the groups surveyed, there are no significant differences found in the following assessment areas: Child Care, Children's Activities, Interaction, Program Structure, Parents and Staff.

Table 01. Results of surveying literacy environment quality

	An area of literacy environment assessment (ECERS-R subscales)	Group 1	Group 2	Variation
1.	Space and Furnishings	3.8	5.1	1.3
2.	Child Care	3.8	4	0.2
3.	Language-Reasoning	3.8	5.5	1.7
4.	Children's Activities	4.1	3.9	0.2
5.	Interaction	6	5.2	0.8
6.	Program Structure	3.3	3	0.3
7.	Parents and Staff	4.2	4	0.2

Substantially significant differences are present in the areas: Space and its Furnishings (1.3) and Language-Reasoning (1.7). Consider the differences that exist in the structure of indicators for each area of literacy environment assessment.

Table 02. Differences in assessments in the structure of the Space and Furnishings indicator

	An area of literacy environment assessment (ECERS-R subscales)	Group 1	Group 2
1.	Indoor space	2	4
2.	Furniture for routine care, play and learning	6	6
3.	Furnishings for relaxation and comfort	6	6
4.	Room arrangement for play	5	5
5.	Space for privacy	1	3
6.	Child-related display	6	6
7.	Space for gross motor play	3	6

8.	Gross motor equipment	1	5
		3.8	5.1

The scores assigned to the groups surveyed are identical in respect to items of furniture (points 2, 3), play space (points 4) and child-related design of space (point 6). At the same time, the space of Group 1 is significantly inferior to that of Group 2 in the arrangement of space for privacy (in Group 1, children do not have the slightest opportunity to be alone since the entire space in the group is open and intended for group activities). Also, the space of Group 1 excludes zones equipped for active games that promote development of children's gross motor skills and physical self-expression (for example, in a mobile game or a dance).

Table 03. Differences in assessing the structure of the Language-Reasoning indicator

	An area of literacy environment assessment (ECERS-R subscales)	Group 1	Group 2
1.	Books and illustrations	5	4
2.	Stimulating of communication	5	6
3.	Using of speech for the mental skills development	1	6
4.	Everyday using of speech	4	6
		3,8	5,5

The Language-Reasoning indicator aims to assess the nature of child-adult communication and conditions for developing children's reasoning skills in the process of communication. Score on The Books and Illustrations parameter indicate that both groups have more or less equal conditions for acquainting children with literature (the groups have small libraries and the care-giver reads books from it to the children at least once a day). The parameter Encouraging communication makes it possible to evaluate the conditions designed to develop interpersonal communication in students within their group (there are enough materials for pair and group games in both groups, caregivers help children to hear one another and to build up good relations with one another).

The greatest difference in the scores is recorded in the parameter Use of language to develop reasoning skills, which aims to assess the way a caregiver introduces new concepts and encourages independent thinking in children. In Group 2, the caregiver is in the process of communicating with children throughout the day.

When talking to them she asks open-ended questions ("What does this figure remind you of?", "How can we build a high tower?", etc.) enabling her to introduce new concepts based on children's actual experience and interest. In Group 1, the caregiver suggests that the children learn new material by memorizing and reproducing the materials they have been given without any regard for the children's experience. The last indicator to be considered in this area is Informal use of language, it allows us to fix the content and emotional features of the caregiver's communication with children. So, the educator in the first group uses language more as a discipline management tool whereas in the second group language also serves the caregiver as a means of interpersonal communication and the development of reasoning skills in children.

Based on the obtained scores of literacy environment quality it is possible to make "portraits" of the groups surveyed at the two daycare centers.

Group 1 is characterized by one-way child-adult communication; the caregiver does not create conditions for the children to actively discuss issues that are of interest to them and to voice their detailed opinions. New concepts are introduced without any regard for the children's actual experiences. The environment lacks proper zoning of space - there is no space for privacy and no zone for mobile games.

Conversely, caregivers in Group 2 are genuinely interested in communicating with children. They often ask children free-answer questions. Communication between teachers and children can be described as bilateral, i.e., adults encourage children to further develop their ideas in their answers. The group's space is organized in such way as to have zones assigned and equipped for mobile and quiet games as well as areas for privacy.

6.2. Results of diagnosing the mental development of pupils in pre-school educational organizations

Consider the results of the mental development of pupils from the two groups (Table 04). Comparison of the results of assessing the mental development of pupils in the two kindergartens groups with different indicators of literacy environment quality made it possible to establish the presence of statistically significant variations in children's performance on most of the methods aiming to diagnose their mental development.

In terms of cognitive development children in Group 2 have a more developed nonverbal intelligence compared with that in Group 1, (19.4 and 7.63 points on average, $U = 30,000$, $p = 0.000$, respectively). They also have better developed working visual memory, in particular, the ability to remember the spatial location of objects (75.60 and 61.68 points on average, $U = 101.500$, $p = 0.012$). In addition, the kids in the second group have better developed working verbal memory (20.67 and 16.73 points, $U = 104.500$, $p = 0.002$).

At the same time, children in the first group are better at doing the card sorting task according to the DCCS method than those in the second group (5.90 and 4.82 points on average, $U = 151.500$, $p = 0.012$, respectively) which testifies to the fact their ability to be flexible in switching between different tasks is more developed.

As for the development of their emotional and personal sphere, the children in Group 2 have a higher level of ToM development (12.00 and 14.48 points on average, $U = 142.000$, $p = 0.03$), and, at the same time, they perform the task of understanding other people's emotions in different situations more successfully (16.40 and 14.79 points on average, $U = 1.603$, $p = 0.04$).

Table 04. Mean and standard deviations of mental development scores

		Group 1		Group 2		Variation
		Mean value	St. variation	Mean value	St. variation	
1.	Raven's Colored progressive matrices (intelligence)	9.95	6.199	23.05	4.925	29.000 0.000
2.	Memory for Design	61.68	16.425	75.60	17.783	101.500

						0.012
3.	Memory for Design (content)	35.16	4.41290	37.70	4.76942	
4.	Memory for Design (space)	7.63	6.35269	19.40	3.66204	30.000 0.000
5.	Sentences Repetition (verbal memory)	16.73	3.312	20.67	3.929	104.500 0.002
6.	Theory of Mind	12.00	3.436	14.48	3.043	142.000 0.030
7.	Test of Emotional Comprehension	14.79	1.548	16.40	1.603	88.000 0.040
	Dimensional Change Card Sort Total Score	19.38	2.906	17.27	2.729	
	Dimensional Change Card Sort PostSwitch	5.90	.301	4.82	1.736	151.500 0.012
	Inhibition, naming, Uncorrected errors	.59	.854	.52	.873	
	Inhibition, naming, corrected errors	1.77	1.020	1.19	1.365	
	Inhibition, naming, time	47.55	10.680	44.48	8.796	
	Inhibition, Uncorrected errors	3.27	4.558	2.48	2.250	
	Inhibition, corrected errors	2.18	1.763	2.00	1.817	
	Inhibition, time	62.00	14.452	61.67	13.987	

Consider the performance by the children in the two groups on individual tasks according to the ToM method. Pupils in Group 2 on average did better in Task 4, the diagnostic purpose of the task was to assess the child's ability to retain both verbal and nonverbal components of communication. The child was asked to listen to a small poem and at the same time to repeat after an adult the simple movements that depicted the events indicated in the poem. As a result of testing, 90.5% of the children in the second group were found to be capable of holding verbal and non-verbal communication components simultaneously. Whereas 31.8% of the children in the first group were able to cope with the given task (the Chi-square criterion, $\chi = 13, 86, p = 0.001$).

Also, statistically significant variations were identified in the children's performance on Task 5, aimed to diagnose a child's ability to distinguish between degrees of reality of various events. So, the task asked a child to select from three images the one that corresponded more to the real life events. 90.5% of the pupils in Group 2 coped with this task, while a mere 31.8% of the pupils did so in Group 1 (the Chi-square criterion, $\chi = 13, 83, p = 0.000$).

Let's consider the children's successful performance on Task 6 aimed to assess the decentration of thinking. In this task, a child had two identical boxes with stickers representing cubes put on the table in front of him. One of them did contain the cubes while the other had pencils in it. After the child learned that there were pencils in one of them, the rater asked him the question: "If your friend comes into the room now, what he will think is in this box?". The results of the children's performance on this task indicate that the students in the second group overcame the egocentrism of reasoning (86.7%) to a greater extent than did the children in the first group (36.4%) (Chi-square criterion, $\chi = 9.53, p = 0.002$).

Now let's consider the performance by the children in both groups of Task 13 Test of Emotional Comprehension. The task is structured in the following way: the rater shows the child the picture of a rabbit sitting by a tree. Then the rater lifts the film, making it possible to a wolf see behind the tree wanting to eat the rabbit. Then the rater asks the child: "Does the rabbit know that there is a wolf hiding behind the tree?" And "What does the rabbit feel?". 44% of the children of the second group and 16.7% of the first (the Chi-square test, $\chi = 3.56$, $p = 0.007$) coped with this task successfully. Thus, the pupils in the second group have a better developed ability for decentration.

So it can be concluded that pupils in the second kindergarten group have a more developed emotional intelligence and theory of mind than those in the first group.

6.3. Discussion of results and summary

The study carried out a comparative analysis of indicators of children's mental development in connection with the quality of the literacy environment that exists in the kindergarten. The study examined in detail two groups from different kindergartens, having significant variations in the environmental parameters associated with the quality of language-reasoning development in children in the process of interaction with the caregiver and space organization. In the groups selected, the most significant variations were recorded in the parameters: Encouraging communication, Use of language for reasoning skills, Informal language. According to the environmental scores obtained, the caregiver in one of the groups is involved in the process of communicating with the children throughout the day, he asks kids open-ended questions, he introduces new concepts based on children's actual experience and interest. In the other group, the caregiver is inclined to teach children new material through memorization and reproduction, without relying on the children's experience. In the groups surveyed there were significant variations in the emotional aspect of communication between the caregiver and the children.

The analysis of the results of comparing mental development indicators in the children of the above groups showed that kindergarten group students with higher quality indicators of the literacy environment parameters that are of interest to us do much better in the cognitive development tests (intelligence and memory) and emotional intelligence (theory of mind and the emotion comprehension). At the same time, children in the first group outperform them in the development level of their ability to switch between different tasks in a flexible way.

Higher indicators of the level of cognitive functions development in children are probably associated with a literacy environment parameter such as Use of language for developing reasoning skills. After all, it is in the process of communicating with an adult that reasoning and memory develop intensively in a preschool child. Thus a caregiver can provide kids with conditions for independent, emotionally colored cognitive activity by asking them open-ended questions, focusing on their interests, allowing children to "live" this or that cognitive situation, by encouraging and developing their ideas and dreams).

In this case, the child will not only master some educational content, but will also train independently to develop solutions by applying these or those reasoning skills. In the opposite case, the caregiver may offer new material for children to learn by memorizing and reproducing it.

In this case, development of reasoning and memory will not be so effective since this pedagogical style does not allow for the child to get to know the surrounding reality on his own and to engage in genuine communication with the adult.

In terms of emotional development, kindergarten group children with higher indicators of literacy environment quality are more successful in coping with the tasks on the emotion comprehension, decentration and theory of mind. We believe that this may be due to the fact that the caregiver is interested in communicating with children and is emotionally involved in it. In the process of interacting with children throughout the day she helps them perceive and become aware of emotional states, thoughts and desires. In other words, in the process of communicating with children, the caregiver develops theory of mind in the child in a better way.

Interestingly enough, where a caregiver fails to maintain a dialogue with her group students during the day, to ask them open-ended questions, to encourage them to express their attitude towards things and to seek solutions to creative and cognitive tasks on their own, those group students tend to demonstrate a better ability to switch between different tasks in a flexible way than kids in another group. It can be assumed that this can be accounted for by the fact that children have a strong urge to meet an adult's expectations. They monitor changes in the instruction more closely and try to bring their activities in line with it as much as possible.

The study involved children from just two Moscow kindergartens. A sample like this does not allow one to fully appreciate the external socio-economic factors associated with the kindergartens' prestigious locations, their distance from the city center and other socioeconomic differences between the families of the preschoolers surveyed that also has an impact on their development. In addition, the study did not directly address the issue of the comprehensive nature and specifics of family education. The effect of the family on the psychological development of preschool children cannot be underestimated.

In connection with all of the above, at the next stage it is planned to increase the sample size and to conduct a more differentiated analysis of the links between individual indicators of literacy environment quality and different lines of mental development in preschool children and more thorough control over socio-demographic and family factors.

7. Conclusion

This study allowed us to confirm the above hypothesis that indicators of mental development of the emotional-personal and cognitive sphere are higher in kindergarten group students with higher indicators of literacy environment quality in terms of child-adult communication and the conditions for children's reasoning skill development in the process of communication.

We assume that the study outcomes reflect important features of the mental development process in children included in this or that literacy environment and in a system of social relationships that exist in it. The study results can serve as a basis for further elaboration of recommendations on how to organize an environment in a pre-school educational institution.

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