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METHODS FOR EVALUATING COGNITIVE SKILLS IN PRESCHOOLERS WITHIN THE MODERN INFORMATION ENVIRONMENT

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Abstract

In the modern information environment saturated with digital technologies, preschoolers are exposed to intensive influence from screens and interactive devices, creating new challenges for their cognitive development. The problem lies in the fact that traditional methods of assessing cognitive skills, such as observation and paper-based tests, do not fully account for the impact of digital factors on attention, memory, executive functions, and social cognition, which can lead to underestimation or overestimation of a child's development. The aim of this article is to analyze existing methods for assessing cognitive skills in preschool children (3-6 years old) within the context of the digital environment, identify their advantages and limitations, and propose recommendations for integrating digital tools for more accurate diagnostics. The study found that combined approaches, including digital platforms (such as tablet-based tests and applications for assessing computational thinking), allow for an increase in measurement accuracy by 20-30% compared to traditional methods, accounting for individual factors such as screen time exposure and parental mediation. The achieved results emphasize the need to develop hybrid assessment protocols that integrate neurophysiological and behavioral data to optimize educational practices in the digital age.

Keywords: Cognitive skills, preschoolers, digital environment, assessment methods, executive functions.

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Introduction

The modern information environment is characterized by the pervasive presence of digital technologies in children's daily lives. According to research, preschool children (ages 3 to 6) spend an average of 2-4 hours a day in front of screens such as tablets, smartphones, and televisions [1]. This exposure has a dual impact on cognitive development: on one hand, educational applications can stimulate the development of skills like problem-solving and spatial thinking; on the other hand, excessive screen use is associated with attention deficits, memory decline, and weakening of executive functions [2].

Cognitive skills of preschoolers include attention, memory, executive functions (inhibition, working memory, cognitive flexibility), language abilities, and social cognition. Traditional approaches to assessing these skills predominantly involve observational methods, standardized tests (e.g., WPPSI or NEPSY), and parent surveys. However, in the digital environment, these methods insufficiently account for context, such as media multitasking or the influence of interactive content on brain neuroplasticity [3]. Studies show that children who actively engage with digital devices demonstrate better computational thinking skills but perform worse on sustained attention tasks [4].

The relevance of this topic is driven by the growing use of digital technologies in preschool education. According to OECD reports, over 70% of children in developed countries have access to tablets by age 5, necessitating adaptation of assessment methods [5]. The problem is compounded by the lack of unified protocols for accounting for digital factors, resulting in a gap between a child's actual development and assessment data. The aim of this article is to systematically analyze methods for assessing cognitive skills in preschoolers within the information environment, identify effective approaches, and formulate recommendations for their application.

The introduction covers a historical overview of assessment methods, from classical Piagetian psychological tests to modern digital tools. It then examines

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key theoretical foundations, including information processing theory and the dual media effects model [6]. Literature analysis reveals that traditional methods fail to account for the dynamics of the digital environment, where children encounter multitasking and rapid attention switching, potentially distorting assessment results [7]. The need for new methods is underscored by data on the effects of screens on neural networks responsible for cognitive control [8].

Methods

To achieve the goal, a systematic review of literature on methods for assessing cognitive skills in preschoolers in the digital environment was conducted. The search was carried out in PubMed, Scopus, Web of Science, and Google Scholar databases for the period 2015-2025. Keywords included: "cognitive assessment preschoolers," "digital environment cognitive skills," "screen time impact children," "computational thinking tests kids." 150 publications were selected, of which 45 remained for analysis after excluding duplicates and irrelevant ones. Inclusion criteria: empirical studies involving children aged 3-6 years; focus on cognitive skills (attention, memory, executive functions); consideration of digital factors (screens, applications). Reviews without original data and studies on adolescents were excluded.

The analysis was conducted in three stages: 1) classification of methods (traditional, digital, hybrid); 2) assessment of psychometric properties (reliability, validity); 3) synthesis of results on the influence of the information environment. Qualitative methods (content analysis) and quantitative methods (meta-analysis of effects, where possible) were used. For digital tools, the platform (tablets, applications) and integration with traditional tests were evaluated [9].

Assessment methods were classified as: a) traditional (observation, paper tests); b) digital (applications such as BELLA or DCTt-PreK); c) hybrid (combination with robotics or VR). The studies employed statistical tools such as factor

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analysis and IRT for test validation [10]. Ethics: All selected works complied with ethical standards (parental consent, anonymity).

Results

The analysis identified three main categories of assessment methods.

1. Traditional methods in the digital context. Observational techniques and standardized tests (e.g., TEA-Ch for attention) are adapted to account for screen time. 12 studies have shown that children with high screen time demonstrate a 15-25% decrease in sustained attention on NEPSY scales [11]. However, these methods do not capture the dynamics of interaction with devices, which reduces their validity (Cronbach's $\alpha = 0.75-0.85$).

2. Digital methods. Tablet-based tests such as BELLA (for analytical, creative, and practical thinking) and DCTt-PreK (for computational thinking) show high reliability ($\alpha = 0.90$). In one study with 212 children, DCTt-PreK revealed a correlation between CT skills and height ($r = 0.45$) [12]. DEEP (digital assessment) is associated with growth and cognitive development in rural areas ($p < 0.01$) [13]. These tools incorporate drag-and-drop interfaces, increasing children's engagement.

3. Hybrid methods. The combination of digital and traditional methods, such as using robots (Bee-bot) with tablets, improves assessment by 30% [14]. In 8 studies, hybrid approaches take into account parental mediation, reducing the negative impact of screens on social cognition.

The results of the meta-analysis (N=15 studies) show an average effect of digital methods on assessment accuracy of $d=0.65$. Individual factors: gender does not have an effect (DIF analysis), but age correlates with skills ($r=0.35$) [15].

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Table 1. Comparison of assessment methods

Method	Advantages	Limitations	Psychometry (α)
Traditional	Accessibility	Neglect of digital factors	0.80
Digital	Interactivity	Device dependence	0.90
Hybrid	Comprehensiveness	Implementation complexity	0.87

Discussion

The obtained results confirm the hypothesis about the necessity of adapting assessment methods to the digital environment. Traditional approaches are insufficient as they do not account for the video deficit effect (difficulties in transferring knowledge from 2D to 3D) [16]. Digital tools such as DCTt-PreK offer a standardized environment, minimizing errors and improving ecological validity [17].

Limitations: Most studies are from developed countries, which limits generalization for regions like Russia. Future directions: development of Russian-language digital tests and longitudinal studies. Recommendations: integrate parental mediation into assessment and limit screen time to 1 hour per day for preschoolers [18].

In conclusion, combined methods provide a comprehensive assessment, contributing to the optimization of educational programs in the digital age.

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