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Technologies for the Integration of Children with Special Educational Needs into the Developing Environment of Preschool Organizations

Abstract

Introduction. In the context of the transformation of the educational paradigm and the shift towards inclusive education, technological solutions are becoming a key factor in ensuring equal opportunities for all categories of learners. This article explores the problem of integrating children with special educational needs (SEN) into the developmental environment of preschool institutions through the use of modern technologies. *Methodology and Methods.* The study involved 27 preschool teachers. The survey included an assessment of material and technical resources, an analysis of the frequency of technology use, and a measurement of teachers' competency levels. *Results.* A critical gap was identified between the needs of inclusive education and the actual conditions for its implementation. Only a small proportion of institutions are fully equipped with the necessary technological resources, while the majority of existing technologies are considered outdated. The findings also reveal differences in how technologies are applied: they are widely used to support socialization and cognitive development, but are far less frequently employed for the correction of behavioral disorders. *Scientific novelty.* It has been experimentally proven that the effectiveness of technological integration of children with SEN is determined not only by the availability of technical means, but also by a complex of interrelated factors. A disproportion between teachers' high motivation to master technologies and their low actual competency in assistive technologies was identified and quantified. *Practical significance.* The research results can be used to develop modernization programs for preschool inclusive education. The identified barriers and teacher needs form the basis for creating a comprehensive system to support technological transformation. The proposed model for assessing technological readiness can be used to monitor the effectiveness of the implementation of digital solutions.

Keywords: children with special educational needs, technologies, developmental environment, preschool institutions.

Introduction. The modern system of preschool education faces a growing challenge associated with a steady increase in the number of children with special educational needs (Liu & Potmesil, 2025; Kamran & Bano, 2025). State support for inclusive education is enshrined in key documents such as the UN Convention on the Rights of Persons with Disabilities, the Salamanca Declaration, and the Law of the Republic of Kazakhstan "On Education". The State Program for the Development of Education and Science for 2020-2025 defines expanding access to quality education for children with SEN as a priority. At the 2025 Global Disability Summit, UNICEF announced commitments for the next five years, which include supporting at least 50 countries in establishing multisectoral early intervention systems to provide individualized services to children with developmental delays and their families (Olusanya, 2025).

However, a significant gap exists between state initiatives and actual practice. According

to research (Bilyalov, 2024; Turlubekova, 2021), preschool institutions in the Republic of Kazakhstan face a complex set of barriers when admitting children with developmental disabilities. The architectural environment of most kindergartens is not adapted for children with musculoskeletal disorders. The subject-based developmental environment does not account for the sensory and cognitive characteristics of children with various impairments. Teachers acknowledge the inadequacy of their training for working in inclusive groups.

Pop (2022) proves the importance of the preschool period for the formation of social competencies and cognitive development. Children with SEN who are included in a peer environment from an early age demonstrate better school adaptation, more developed communication skills, and greater independence. Concurrently, typically developing children develop tolerance, empathy, and a readiness for mutual assistance. At the same time, the mere formal presence of a child with disabilities in a group without systemic support creates risks for all participants in the educational process. Children with SEN may experience increased social isolation and develop secondary emotional disorders. Typically developing children, without pedagogical support in understanding their peers' differences, may form stigmatizing attitudes.

Winter & O'Raw (2010) offer individual solutions: methods for adapting the environment for specific conditions, teacher professional development programs, and models of psychological support for families. However, a holistic system of technologies that integrates all aspects of inclusion and considers the specifics of preschool-age remains underdeveloped. Key problems require technological solutions: how to transform the physical space of a kindergarten into an accessible and developmental environment for children with diverse needs; what pedagogical tools will ensure the meaningful inclusion of every child in the educational process; how to build productive collaboration among specialists of different profiles; how to involve families in the integration process; how to

prepare the parent community to accept children with developmental differences. The study aims to assess the current state and prospects for the application of digital technologies in the inclusive practice of preschool education.

The issue of integrating children with special educational needs into the educational environment of preschool organizations is attracting increasing attention from researchers in various countries worldwide. Contemporary scientific research focuses on studying effective technologies and methods that promote the successful adaptation and learning of children with various developmental disorders in inclusive educational settings.

Assistive and information and communication technologies play a key role in the process of integrating children with SEN. A study by Al-Attayah et al., (2022), conducted in Qatar with 183 early intervention program teachers, revealed a high level of assistive technology use in educating children with disabilities. Notably, the researchers found no statistically significant differences in the application of technologies based on teachers' work experience, their specialization, or the level of students' disabilities, indicating the universality of this approach (Al-Attayah et al., 2022).

Similar findings were obtained in a study by Al-Dababneh and Al-Zboon (2022), who examined the beliefs and professionalism of teachers regarding the use of assistive technologies in inclusive classrooms in Jordan. The study involved 157 teachers working with children with specific learning difficulties. The results showed a high level of teachers' self-assessment regarding the use of assistive technologies, with the perception of their own professionalism in using technologies scoring the highest, while the availability of assistive technologies received the lowest ratings. The study revealed a statistically significant correlation between teachers' beliefs and their professionalism, and also showed differences in technology availability between public and private schools in favor of the latter (Al-Dababneh & Al-Zboon, 2022).

A large-scale study in Ecuador by Segura et al., (2024) aimed to analyze the transformation

of teaching methods supported by ICT for children with physical impairments. The study used a non-experimental design with a quantitative approach, involving 61 teachers. Correlation analysis revealed a significant positive relationship between ICT and inclusive teaching strategies ($r=0.976$, $p<0.01$), demonstrating that technological infrastructure and pedagogical competencies are determining factors for developing effective inclusive strategies. However, barriers such as a lack of adapted resources and specific teacher training were identified (Segura et al., 2024).

A promising direction is the use of various technological agents in teaching children with developmental disorders. Kirsal and Kahveci (2024) investigated the effectiveness of the simultaneous prompting method combined with small-group instruction using computer projection, SMART interactive whiteboards, tablet computers, and humanoid robots. The study involved 14 children with developmental disorders aged 10-15 years. Graphical analysis demonstrated the effectiveness of computerized simultaneous prompting using various technologies. The results showed that participants maintained the acquired skills and applied them to various tools, equipment, and people at the first, third, and fourth weeks after the intervention. The study also highlighted the high accuracy of participants' skill acquisition through observational learning (Kirsal & Kahveci, 2024).

Augmented reality technologies show significant potential for integrating children with SEN. Patiño et al., (2023) proposed an evaluation of the learning process for children with autism spectrum disorders through a mobile application with augmented reality. The authors emphasize that augmented reality technologies significantly improve the neurocognitive situation of children with ASD, allowing them to interact and communicate openly with both the real and digital worlds. The proposed augmented reality environment, which uses mobile devices for marker processing, enables children with ASD to interact and consolidate learning in a more dynamic way (Patiño et al., 2023).

An innovative approach to creating an adapted subject-developmental environment is the use of 3D printing for toy production. Jovanovic et al., (2023) presented a case study from Montenegro, emphasizing that toys have a significant impact on children's cognitive development, sensory perception, and creativity, as well as teaching children about themselves and their environment. 3D printing, as a rapidly developing technology, has found application in education and is particularly useful for manufacturing toys for children with disabilities, as the materials used are recyclable, eco-friendly, and can be created according to their specific needs (Jovanovic et al., 2023).

Researchers pay special attention to distance learning technologies for children with motor impairments. Ananchenkova and Volkova (2020) note that distance learning has a number of features that make it highly effective in working with children with disabilities, particularly those with cerebral palsy. The use of distance learning for children with motor pathologies allows for the consideration of each child's needs, interests, and capabilities, enabling lessons to be conducted at a convenient and suitable time for them, while ensuring an individual pace of progress in mastering the educational material (Ananchenkova & Volkova, 2020).

A revolutionary direction in integration technologies is the application of artificial intelligence. Ghafghazi et al., (2021) presented an AI-ABA (AI-augmented learning and applied behavior analytics) platform to provide personalized treatment and learning plans for individuals with autism, intellectual disabilities, and developmental disorders. By defining systematic experiments alongside automated data collection and analysis, AI-ABA can promote self-regulating behavior using reinforcement-based augmented or virtual reality and other mobile platforms, helping clinicians focus on making accurate, data-driven decisions and enhancing the quality of individualized interventions (Ghafghazi et al., 2021).

The effectiveness of using mobile technologies in developing communication skills in children with autism spectrum disorders

was demonstrated by Alzrayer, Banda, and Koul (2017). A study involving four children aged 8 to 10 years with ASD and other developmental disorders showed the effectiveness of systematic instruction in multi-step requesting skills using an iPad with the Proloquo2Go application. The results demonstrate that the intervention was effective in increasing multi-step requests. All participants, to varying degrees, successfully navigated the pages and combined symbols to request preferred items, demonstrating generalization of the newly acquired skills (Alzrayer et al., 2017). The conducted literature review indicates that modern technologies for integrating children with SEN are characterized by a significant diversity of approaches and methods. This study aims to comprehensively investigate technologies for supporting children with special educational needs (SEN) in preschool educational organizations of the Republic of Kazakhstan, using the city of Taraz as an example.

Materials and Methods. *Participants.* As part of an empirical study, a survey of 27 preschool teachers in the city of Taraz was conducted using the questionnaire method. The sample included teachers directly working with preschool-aged children, including children with special educational needs. A structured questionnaire, "The Use of Technologies in Working with Children with Special Educational Needs", was developed for data collection, allowing for a comprehensive assessment of the current state and prospects of using digital technologies in the inclusive practice of preschool education.

Data Collection Tools. The presented questionnaire for preschool teachers, "The Use of Technologies in Working with Children with Special Educational Needs", is a comprehensive research tool designed to study the current state and prospects of using digital technologies in inclusive preschool education. The questionnaire's structure covers eight interconnected blocks, providing a holistic picture of the technological readiness of teachers and organizations.

The questionnaire begins by examining the professional profile of the respondents, including teaching experience, education

level, experience working with children with SEN, and any specialized training completed. Next, the material and technical resources of the preschool organizations are investigated by identifying available equipment from basic computers to specialized assistive devices and educational robots, with an assessment of their availability and technical condition. The third block focuses on the practical aspects of technology use: frequency of use, target areas of work, and specific programs used for developing cognitive abilities, speech, motor skills, socialization, and correction.

The main part of the questionnaire consists of an assessment of the effectiveness of technologies through ten key statements, measured on a five-point Likert scale. Respondents evaluate the impact of technologies on children's motivation, the individualization of the educational process, the development of various skills, social adaptation, and the creation of an inclusive environment. Simultaneously, the self-assessment of teachers' professional competence in the field of digital technologies, knowledge of assistive technologies, and the ability to select and integrate technologies according to the individual needs of children are examined.

Particular attention is paid to identifying barriers that hinder the effective use of technologies, ranging from a lack of equipment and teaching materials to a deficit in knowledge and absence of technical support. The questionnaire investigates practices of interaction with parents and specialists regarding the use of technologies, including recommendations for home use and interdisciplinary collaboration. The tool concludes with a prospective planning section, where teachers indicate desired technologies - from interactive whiteboards to artificial intelligence systems - identify the necessary support for professional development, and express their readiness to share experiences with colleagues.

Results and Discussion. Methodologically, the questionnaire combines closed-ended multiple-choice questions and rating scales, ensuring the collection of quantitative data for statistical analysis (Tables 1,2).

Table 1*Survey Results*

Block 1. General information about the respondent

Your teaching experience:

	Frequency	Percentages	Valid Percent	Cumulative Percent
Your teaching work experience:				
Valid	up to 3 years	3	11,1	11,1
	3-5 years	9	33,3	44,4
	6-10 years	8	29,6	74,1
	11-15 years	4	14,8	88,9
	more than 15 years	3	11,1	100,0
	Total	27	100,0	100,0

Your education:

Valid	Secondary vocational	7	25,9	25,9
	Higher (pedagogical)	12	44,4	70,4
	Higher (specialized)	6	22,2	92,6
	Other	2	7,4	100,0
	Total	27	100,0	100,0

Do you have experience working with children with SEN?

Valid	Yes	17	63,0	63,0
	No	10	37,0	100,0
	Total	27	100,0	100,0

Have you completed professional development courses on working with children with SEN?

Valid	Yes	10	37,0	37,0
	No	13	48,1	85,2
	I plan to	4	14,8	100,0
	Total	27	100,0	100,0

Block 2. Availability and Accessibility of Technologies

Please assess the availability of technologies in your organization

	Frequency	Percentages	Valid Percent	Cumulative Percent
Valid	completely unavailable	3	11,1	11,1
	practically unavailable	6	22,2	33,3
	available only for specific groups	8	29,6	63,0
	available, but in limited quantity	7	25,9	88,9
	fully available and in sufficient quantity	3	11,1	100,0
	Total	27	100,0	100,0

Please assess the technical condition of the equipment

Valid	not available	0	0,0	0,0	0,0
	unsatisfactory (frequently malfunctions)	9	33,3	33,3	33,3
	satisfactory (outdated but operational)	14	51,9	51,9	85,2
	good (functional, in working order)	4	14,8	14,8	100,0
	excellent (new, modern)	0	0,0	0,0	100,0
	Total	27	100,0	100,0	

What technologies are available in your preschool organization for working with children with SEN?

Valid	Computer/laptop				
	Not available (0)	6	22,2	22,2	22,2
	Available (1)	21	77,8	77,8	100,0
	Total	27	100,0	100,0	
	Interactive whiteboard				
	Not available (0)	14	51,9	51,9	51,9
	Available (1)	13	48,1	48,1	100,0
	Total	27	100,0	100,0	
	Tablets				
	Not available (0)	15	55,6	55,6	55,6
	Available (1)	12	44,4	44,4	100,0
	Total	27	100,0	100,0	
	Projector				
	Not available (0)	5	18,5	18,5	18,5
	Available (1)	22	81,5	81,5	100,0
	Total	27	100,0	100,0	
	Specialized Software				
	Not available (0)	24	88,9	88,9	88,9
	Available (1)	3	11,1	11,1	100,0
	Total	27	100,0	100,0	
	Assistive devices				
	Not available (0)	20	74,1	74,1	74,1
	Available (1)	7	25,9	25,9	100,0
	Total	27	100,0	100,0	
	Audio/video equipment				
	Not available (0)	11	40,7	40,7	40,7
	Available (1)	16	59,3	59,3	100,0
	Total	27	100,0	100,0	
	Touch panels				
	Not available (0)	17	63,0	63,0	63,0
	Available (1)	10	37,0	37,0	100,0
	Total	27	100,0	100,0	
	Educational robots				
	Not available (0)	22	81,5	81,5	81,5
	Available (1)	5	18,5	18,5	100,0
	Total	27	100,0	100,0	
	Technologies are not available				
	No (0)	24	88,9	88,9	88,9
	Yes (1)	3	11,1	11,1	100,0
	Total	27	100,0	100,0	

Block 3. Use of Technologies in Working with Children with SEN

Frequency_of_use	Frequency	Percentages	Valid Percent	Cumulative Percent	
Valid	daily	3	11,1	11,1	11,1
	2-3 times a week	4	14,8	14,8	25,9
	once a week	7	25,9	25,9	51,9
	1-2 times a month	5	18,5	18,5	70,4
	rarely	2	7,4	7,4	77,8
	I do not use	6	22,2	22,2	100,0
	Total	27	100,0	100,0	

For what purposes do you use technologies when working with children with SEN? (you may select multiple options)

	Cognitive development				
Valid	Not used(0)	6	22,2	22,2	22,2
	Used (1)	21	77,8	77,8	100,0
	Total	27	100,0	100,0	
	Speech development				
	Not used(0)	10	37,0	37,0	37,0
	Used (1)	17	63,0	63,0	100,0
	Total	27	100,0	100,0	
	Fine motor skills				
	Not used(0)	10	37,0	37,0	37,0
	Used (1)	17	63,0	63,0	100,0
	Total	27	100,0	100,0	
	Socialization				
	Not used(0)	5	18,5	18,5	18,5
	Used (1)	22	81,5	81,5	100,0
	Total	27	100,0	100,0	
	Behavior correction				
	Not used(0)	19	70,4	70,4	70,4
	Used (1)	8	29,6	29,6	100,0
	Total	27	100,0	100,0	
	Emotional development				
	Not used(0)	14	51,9	51,9	51,9
	Used (1)	13	48,1	48,1	100,0
	Total	27	100,0	100,0	
	Daily living skills				
	Not used(0)	14	51,9	51,9	51,9
	Used (1)	13	48,1	48,1	100,0
	Total	27	100,0	100,0	
	Assessment				
	Not used(0)	16	59,3	59,3	59,3
	Used (1)	11	40,7	40,7	100,0
	Total	27	100,0	100,0	

Block 4. Evaluation of Technology Effectiveness

The use of technologies increases motivation for learning in children with SEN

	Frequency	Percentages	Valid Percent	Cumulative Percent
Valid	1	3	11,1	11,1
	2	3	11,1	22,2
	3	2	7,4	29,6
	4	14	51,9	81,5
	5	5	18,5	100,0
	Total	27	100,0	

Technologies help to individualize the educational process

Valid	1	2	7,4	7,4
	2	3	11,1	18,5
	3	4	14,8	33,3
	4	10	37,0	70,4
	5	8	29,6	100,0
	Total	27	100,0	

The application of technologies promotes the development of cognitive abilities in children with SEN

Valid	1	3	11,1	11,1
	2	2	7,4	18,5
	3	3	11,1	29,6
	4	11	40,7	70,4
	5	8	29,6	100,0
	Total	27	100,0	

Technologies are effective for developing communication skills

Valid	1	4	14,8	14,8
	2	2	7,4	22,2
	3	4	14,8	37,0
	4	9	33,3	70,4
	5	8	29,6	100,0
	Total	27	100,0	

The use of technologies improves the social adaptation of children with SEN

Valid	1	2	7,4	7,4
	2	1	3,7	11,1
	3	9	33,3	44,4
	4	6	22,2	66,7
	5	9	33,3	100,0
	Total	27	100,0	

Technologies enable more effective monitoring of a child's developmental progress

Valid	1	2	7,4	7,4
	2	5	18,5	25,9
	3	5	18,5	44,4
	4	6	22,2	66,7
	5	9	33,3	100,0
	Total	27	100,0	

The use of technologies saves teacher time

Valid	1	2	7,4	7,4
	2	3	11,1	18,5
	3	4	14,8	33,3

	4	9	33,3	33,3	66,7
	5	9	33,3	33,3	100,0
	Total	27	100,0	100,0	

Technologies facilitate the involvement of parents in the educational process

Valid	1	1	3,7	3,7	3,7
	2	1	3,7	3,7	7,4
	3	8	29,6	29,6	37,0
	4	9	33,3	33,3	70,4
	5	8	29,6	29,6	100,0
	Total	27	100,0	100,0	

My level of proficiency with computers and digital technologies

Valid	1	3	11,1	11,1	11,1
	2	2	7,4	7,4	18,5
	3	7	25,9	25,9	44,4
	4	12	44,4	44,4	88,9
	5	3	11,1	11,1	100,0
	Total	27	100,0	100,0	

My knowledge of assistive technologies for children with SEN

Valid	1	2	7,4	7,4	7,4
	2	4	14,8	14,8	22,2
	3	15	55,6	55,6	77,8
	4	5	18,5	18,5	96,3
	5	1	3,7	3,7	100,0
	Total	27	100,0	100,0	

My ability to select technologies according to the individual needs of a child with SEN

Valid	1	1	3,7	3,7	3,7
	2	3	11,1	11,1	14,8
	3	12	44,4	44,4	59,3
	4	9	33,3	33,3	92,6
	5	2	7,4	7,4	100,0
	Total	27	100,0	100,0	

My ability to integrate technologies into the educational process

Valid	1	1	3,7	3,7	3,7
	2	1	3,7	3,7	7,4
	3	12	44,4	44,4	51,9
	4	10	37,0	37,0	88,9
	5	3	11,1	11,1	100,0
	Total	27	100,0	100,0	

My knowledge of specialized software for children with different diagnoses

Valid	1	3	11,1	11,1	11,1
	2	11	40,7	40,7	51,9
	3	9	33,3	33,3	85,2
	4	1	3,7	3,7	88,9
	5	3	11,1	11,1	100,0
	Total	27	100,0	100,0	

My readiness to learn new technologies for working with children with SEN

Valid	1	1	3,7	3,7	3,7	
	3	5	18,5	18,5	22,2	
	4	7	25,9	25,9	48,1	
	5		14	51,9	51,9	100,0
	Total		27	100,0	100,0	

Barrier (outdated equipment)

Valid	0		5	18,5	18,5	18,5
	1		22	81,5	81,5	100,0
	Total		27	100,0	100,0	

Barrier (No teaching materials)

	0		9	33,3	33,3	33,3
	1		18	66,7	66,7	100,0
	Total		27	100,0	100,0	

Barrier (lack of knowledge)

Valid	0		12	44,4	44,4	44,4
	1		15	55,6	55,6	100,0
	Total		27	100,0	100,0	

Barrier (No technical support)

Valid	0		23	85,2	85,2	85,2
	1		4	14,8	14,8	100,0
	Total		27	100,0	100,0	

Barrier (lack of time)

Valid	0		16	59,3	59,3	59,3
	1		11	40,7	40,7	100,0
	Total		27	100,0	100,0	

Barrier (high cost of software)

Valid	0		20	74,1	74,1	74,1
	1		7	25,9	25,9	100,0
	Total		27	100,0	100,0	

Barrier (administration resistance)

Valid	0		18	66,7	66,7	66,7
	1		9	33,3	33,3	100,0
	Total		27	100,0	100,0	
	Total		27	100,0	100,0	

Block 5. Prospects and Needs

What support do you need for more effective use of technologies? (you may select multiple options)

Support: Professional Development Courses

		Frequency	Percentages	Valid Percent	Cumulative Percent
Valid	0	6	22,2	22,2	22,2
	1	21	77,8	77,8	100,0
	Total	27	100,0	100,0	

Support: Master Classes					
Valid	0	11	40,7	40,7	40,7
	1	16	59,3	59,3	100,0
	Total	27	100,0	100,0	
Support: Teaching Guides					
Valid	0	8	29,6	29,6	29,6
	1	19	70,4	70,4	100,0
	Total	27	100,0	100,0	
Support: Experience Sharing					
Valid	0	6	22,2	22,2	22,2
	1	21	77,8	77,8	100,0
	Total	27	100,0	100,0	
Support: Specialized Technical Support					
Valid	0	12	44,4	44,4	44,4
	1	15	55,6	55,6	100,0
	Total	27	100,0	100,0	
Support: Financial Support					
Valid	0	10	37,0	37,0	37,0
	1	17	63,0	63,0	100,0
	Total	27	100,0	100,0	
Willingness to share experience					
Valid	1	13	48,1	48,1	48,1
	2	6	22,2	22,2	70,4
	3	5	18,5	18,5	88,9
	4	3	11,1	11,1	100,0
	Total	27	100,0	100,0	

Table 2*Overall Summary (Descriptive Statistics)*

	№	Range	Mini- mum	Maxi- mum	Sum	Mean	Standard	Variance			Skewness	Kurtosis	
							Deviation	Statistics		Standard	Statistics	Standard	
							Error		Error			Error	
Work experience	27	4	1	5	76	2,81	,227	1,178	1,387	,387	,448	-,540	,872
Education	27	3	1	4	57	2,11	,172	,892	,795	,473	,448	-,321	,872
Experience working with SEN	27	1	1	2	37	1,37	,095	,492	,242	,569	,448	-1,817	,872
Courses on SEN	27	2	1	3	48	1,78	,134	,698	,487	,335	,448	-,804	,872
Technology training	27	2	1	3	47	1,74	,114	,594	,353	,122	,448	-,347	,872
Tech. computer	27	1	0	1	21	,78	,082	,424	,179	-1,416	,448	,000	,872
Tech. interactive whiteboard	27	1	0	1	13	,48	,098	,509	,259	,079	,448	-2,160	,872
Tech. tablets	27	1	0	1	12	,44	,097	,506	,256	,237	,448	-2,106	,872
Tech. projector	27	1	0	1	22	,81	,076	,396	,157	-1,718	,448	1,021	,872
Tech. specialized software	27	1	0	1	3	,11	,062	,320	,103	2,623	,448	5,265	,872
Tech. assistive devices	27	1	0	1	7	,26	,086	,447	,199	1,164	,448	-,702	,872

Tech. audio video	27	1	0	1	16	,59	,096	,501	,251	-,399	,448	-1,994	,872
Tech. touch panels	27	1	0	1	10	,37	,095	,492	,242	,569	,448	-1,817	,872
Tech. robots	27	1	0	1	5	,19	,076	,396	,157	1,718	,448	1,021	,872
Tech. not available	27	1	0	1	3	,11	,062	,320	,103	2,623	,448	5,265	,872
Availability of technologies	27	4	1	5	82	3,04	,229	1,192	1,422	-,076	,448	-,763	,872
Technical condition	27	2	2	4	76	2,81	,131	,681	,464	,247	,448	-,711	,872
Frequency of use	27	5	1	6	98	3,63	,321	1,668	2,781	,105	,448	-1,065	,872
Purpose (cognitive development)	27	1	0	1	21	,78	,082	,424	,179	-1,416	,448	,000	,872
Purpose (speech development)	27	1	0	1	17	,63	,095	,492	,242	-,569	,448	-1,817	,872
Purpose (fine motor skills)	27	1	0	1	17	,63	,095	,492	,242	-,569	,448	-1,817	,872
Purpose (socialization)	27	1	0	1	22	,81	,076	,396	,157	-1,718	,448	1,021	,872
Purpose (behavior correction)	27	1	0	1	8	,30	,090	,465	,217	,946	,448	-1,201	,872
Purpose (emotional development)	27	1	0	1	13	,48	,098	,509	,259	,079	,448	-2,160	,872
Purpose (daily living skills)	27	1	0	1	13	,48	,098	,509	,259	,079	,448	-2,160	,872
Purpose (assessment)	27	1	0	1	11	,41	,096	,501	,251	,399	,448	-1,994	,872
Prog. (educational games)	27	1	0	1	22	,81	,076	,396	,157	-1,718	,448	1,021	,872
Prog. (speech therapy apps)	27	1	0	1	9	,33	,092	,480	,231	,749	,448	-1,560	,872
Prog. (AR applications)	27	1	0	1	9	,33	,092	,480	,231	,749	,448	-1,560	,872
Prog. (AAC programs)	27	1	0	1	8	,30	,090	,465	,217	,946	,448	-1,201	,872
Prog. (interactive books)	27	1	0	1	13	,48	,098	,509	,259	,079	,448	-2,160	,872
Prog. (video lessons)	27	1	0	1	22	,81	,076	,396	,157	-1,718	,448	1,021	,872
Prog. (music applications)	27	1	0	1	11	,41	,096	,501	,251	,399	,448	-1,994	,872
Prog. (art therapy)	27	1	0	1	13	,48	,098	,509	,259	,079	,448	-2,160	,872
Prog. (corrective programs)	27	1	0	1	13	,48	,098	,509	,259	,079	,448	-2,160	,872
Prog. (not used)	27	1	0	1	3	,11	,062	,320	,103	2,623	,448	5,265	,872
Effect (motivation)	27	4	1	5	96	3,56	,241	1,251	1,564	-,964	,448	-,052	,872
Effect (individualization)	27	4	1	5	100	3,70	,238	1,235	1,524	-,840	,448	-,130	,872
Effect (cognitive development)	27	4	1	5	100	3,70	,249	1,295	1,678	-1,004	,448	,072	,872
Effect (communication skills)	27	4	1	5	96	3,56	,269	1,396	1,949	-,765	,448	-,600	,872
Effect (social adaptation)	27	4	1	5	100	3,70	,232	1,203	1,447	-,664	,448	-,072	,872
Effect (progress tracking)	27	4	1	5	96	3,56	,258	1,340	1,795	-,439	,448	-1,056	,872
Effect (time saving)	27	4	1	5	101	3,74	,242	1,259	1,584	-,844	,448	-,207	,872
Effect (parental involvement)	27	4	1	5	103	3,81	,200	1,039	1,080	-,712	,448	,483	,872

Comp. (computer proficiency)	27	4	1	5	91	3,37	,221	1,149	1,319	-,808	,448	,100	,872
Comp. (knowledge of assistive technologies)	27	4	1	5	80	2,96	,173	,898	,806	-,268	,448	,805	,872
Comp. (technology selection)	27	4	1	5	89	3,30	,176	,912	,832	-,325	,448	,501	,872
Comp. (integration into the process)	27	4	1	5	94	3,48	,172	,893	,798	-,465	,448	1,193	,872
Comp. (knowledge of specialized software)	27	4	1	5	71	2,63	,214	1,115	1,242	,818	,448	,429	,872
Comp. (willingness to learn)	27	4	1	5	114	4,22	,195	1,013	1,026	-1,443	,448	2,337	,872
Barrier (lack of equipment)	27	1	0	1	20	,74	,086	,447	,199	-1,164	,448	-,702	,872
Barrier (outdated equipment)	27	1	0	1	22	,81	,076	,396	,157	-1,718	,448	1,021	,872
Barrier (no teaching materials)	27	1	0	1	18	,67	,092	,480	,231	-,749	,448	-1,560	,872
Barrier (lack of knowledge)	27	1	0	1	15	,56	,097	,506	,256	-,237	,448	-2,106	,872
Barrier (no technical support)	27	1	0	1	4	,15	,070	,362	,131	2,099	,448	2,594	,872
Barrier (lack of time)	27	1	0	1	11	,41	,096	,501	,251	,399	,448	-1,994	,872
Barrier (high cost of software)	27	1	0	1	7	,26	,086	,447	,199	1,164	,448	-,702	,872
Barrier (administration resistance)	27	1	0	1	9	,33	,092	,480	,231	,749	,448	-1,560	,872
Support (professional development courses)	27	1	0	1	21	,78	,082	,424	,179	-1,416	,448	,000	,872
Support (master classes)	27	1	0	1	16	,59	,096	,501	,251	-,399	,448	-1,994	,872
Support (teaching guides)	27	1	0	1	19	,70	,090	,465	,217	-,946	,448	-1,201	,872
Support (experience sharing)	27	1	0	1	21	,78	,082	,424	,179	-1,416	,448	,000	,872
Support (specialized technical support)	27	1	0	1	15	,56	,097	,506	,256	-,237	,448	-2,106	,872
Support (financial support)	27	1	0	1	17	,63	,095	,492	,242	-,569	,448	-1,817	,872
Willingness to share experience	27	3	1	4	52	1,93	,206	1,072	1,148	,765	,448	-,743	,872
N valid (by list)	27												

The results reveal a complex picture of the current state of technological integration for children with special educational needs within the preschool education system. The study, which involved 27 preschool teachers, identified a significant contradiction between the specialists' high level of education and their insufficient training for working with modern technologies in an inclusive environment. While two-thirds

of the respondents have a higher education, and 63% work directly with children with SEN, only 37% have completed specialized professional development courses in this area.

The results indicate a critical state of the material and technical resources in preschool organizations. Full availability of technologies in sufficient quantity was reported in only 11.1% of cases, while a third of the organizations are

characterized by an almost complete lack of necessary equipment. The technical condition of the existing technological means is assessed as outdated or unsatisfactory in 85.2% of cases, creating significant obstacles for effective work with children with special educational needs.

The analysis of the frequency of technology use reveals insufficient integration of digital tools into daily pedagogical practice. Daily use of technologies was recorded for only 11.1% of teachers, while 22.2% do not use them at all. The mean frequency of use is 3.63 with a high standard deviation of 1.668, indicating significant heterogeneity in technology application practices among different organizations and teachers.

The results identify a differentiated approach to the use of technologies in various areas of development for children with SEN. Technologies are used most actively for socialization (81.5%), cognitive development (77.8%), and individual work (63%). Conversely, only 29.6% of teachers use technologies for behavior correction, indicating an insufficient understanding of the potential of digital tools in corrective pedagogy.

Despite the existing limitations, teachers demonstrate a high assessment of the effectiveness of technologies. The mean effectiveness scores are 3.56 for increasing motivation, 3.70 for individualizing the educational process, and 3.70 for developing cognitive abilities. The potential of technologies for engaging parents in the educational process is rated particularly highly (mean score 3.81), underscoring the importance of technologies as a tool for creating a unified educational space.

Statistical analysis of teacher competence reveals significant gaps in professional training. Knowledge of assistive technologies is below average (2.96), while knowledge of specialized software for children with different diagnoses is only 2.63. At the same time, the readiness-to-learn indicator reaches 4.22, demonstrating negative skewness (-1.443), which indicates high motivation for professional development among the majority of teachers.

The study identifies key barriers hindering effective technology integration. Outdated equipment is noted by 81.5% of respondents, lack of equipment by 74.1%, absence of teaching

materials by 66.7%, and lack of knowledge by 55.6%. Notably, administrative barriers and resistance from management are reported by only a third of respondents (33.3%), suggesting that administrative readiness for innovation is hindered when the necessary resources are available.

The analysis of support needs demonstrates a clear understanding by teachers of the necessary interventions. Professional development courses are needed by 77.8% of respondents, with the same percentage emphasizing the importance of sharing experiences with colleagues. Teaching manuals are required by 70.4% of teachers, specialist consultations by 63%, and financial support by 63%. The high consistency in assessing needs points to the systemic nature of the problems and the necessity for a comprehensive approach to their resolution.

Analysis of variance for the indicators reveals significant variability across most parameters, indicating uneven development of technological inclusion within the preschool education system. Coefficients of variation for key indicators exceed 30%, pointing to substantial differences between organizations in the level of technological readiness and the practice of using digital tools.

The study's results demonstrate that the process of technological integration for children with special educational needs is at an early stage of development, characterized by high potential alongside significant systemic constraints. The identified gap between teacher motivation and available resources requires immediate comprehensive measures, including modernization of the material and technical base, development of specialized teaching materials, and systematic professional development for teachers. Without targeted state policy and substantial investment in the technological infrastructure of preschool education, achieving the goals of inclusion will remain declarative.

Conclusion. An analysis of the empirical data from the conducted study on technology integration for children with special educational needs into the developmental environment of preschool organizations reveals a contradiction between the declared goals of inclusive education and the real conditions for their

implementation. The high motivation of the teaching community to master new technologies and the recognition of their effectiveness for various aspects of development in children with SEN clash with systemic constraints of an infrastructural, methodological, and competency nature. This contradiction creates a situation of a “technology gap”, where the potential of modern digital solutions remains unrealized due to the absence of necessary conditions for their implementation. The identified unevenness in the development of technological inclusion among different preschool organizations creates risks of deepening educational inequality. Children with special educational needs attending institutions with better technological resources gain significant advantages in development and socialization compared to children in organizations where such opportunities are absent.

The concentration of efforts on socialization and cognitive development, coupled with insufficient attention to corrective work, indicates an incomplete understanding by teachers of the spectrum of possibilities offered by modern technological solutions. There is a need to develop comprehensive methodological recommendations demonstrating the effectiveness of technologies for the entire continuum of educational and correctional-developmental tasks. Overcoming the competency deficit among teachers is of paramount importance for successful technology integration. The identified gap between general pedagogical qualifications and specialized technological competencies necessitates the creation of a multi-level system of professional development, encompassing both basic training in digital technologies and advanced study

of specialized tools for working with various categories of children with SEN.

The study’s results substantiate the necessity of transitioning from fragmented initiatives to a systemic state policy for the technological modernization of preschool inclusive education. Such a policy should include: targeted funding for updating material and technical resources; creating a national repository of adapted educational technologies; establishing a network of resource centers for methodological support; developing professional standards in the application of technologies in inclusive education; and creating a system for monitoring the effectiveness of technology integration.

Prospects for further research are associated with studying the differential effectiveness of various technological solutions for specific categories of children with SEN, developing criteria for assessing the readiness of preschool organizations for technological transformation, and creating predictive models for the development of an inclusive educational environment in the context of digitalization. Only a comprehensive, scientifically grounded approach to technology integration will realize the principle of equal educational opportunities and ensure the full development of every child, regardless of their individual characteristics.

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