**Changing Societies & Personalities**, 2023
**Vol. 7, No. 1**, pp. 149–172
https://doi.org/10.15826/csp.2023.7.1.223

ARTICLE

# Markers of Sensory Well-Being in the Learning Environment for Children With Autism Spectrum Disorders

*Lyudmila V. Tokarskaya,*
*Tatyana Yu. Bystrova*
Ural Federal University, Yekaterinburg, Russia

**ABSTRACT**
The article describes the results of interdisciplinary research focusing on the concept of sensory well-being and its application to construct sensory-friendly learning environments. The article analyzes the relationship between sensory characteristics of a learning environment and its impact on children's well-being and progress. It is shown that the current standards for learning environments in Russian schools fail to meet the sensory needs of children with autism spectrum disorders (ASD). The study relies on the case study method to compare the sensory needs a student with ASD and the characteristics of the classroom environment where she studies. The assessment encompasses auditory, visual, olfactory, tactile, vestibular, and proprioceptive modalities. Based on the data obtained, the authors formulate a set of markers that can be used to build a sensory-friendly learning environment. These markers can be used by specialists when designing new or renovating the already existing environments at schools and other educational institutions.

**KEYWORDS**
sensory well-being, learning environment, educational environment, markers, autism spectrum disorders, hypersensitivity, design-technology

Received 18 August 2022
Accepted 10 March 2023
Published online 10 April 2023


liydmil@mail.ru
taby27@yandex.ru

## Introduction

People with autism spectrum disorders (ASD) may face challenges in communication and social interactions and experience behavior problems, which may vary significantly from one individual to another. Moreover, these individuals frequently have sensory hypersensitivity (Happé, 1994; Morozov, 2014). As F. Happé (1994) puts it, these children reacted very violently to certain sounds such as the sound of the vacuum cleaner, noise of the elevator, and even wind blowing. What is more, some of them had difficulty with food intake or unusual food preferences. In addition, there is something that parents and specialists pay less attention to—ASD children's hypersensitivity to external factors, to the emotional structure and physical characteristics of their environment. The existing disorders of sensory processing and higher integrative functions in children with ASD should be considered when analyzing their sensory profile, including the information obtained from parents and teachers (Fernández-Andrés et al., 2015). There is evidence that the most affected sensory modalities in children with ASD are auditory and tactile (Fernández-Andrés et al., 2015).

For people with ASD, the external environment comprises not only their physical surroundings but also other people. The environment can have a strong influence on them, and this influence can be either positive or negative. They, however, may have trouble communicating the emotions induced by the environment. Autistic people may exhibit a variety of atypical sensory characteristics, for example, they may be intolerant to certain sounds, or they may display heightened sensitivity to contact with a particular surface or have unusual smell sensitivity. These characteristics should be given due consideration when designing physical environment for people with ASD, first and foremost, their physical learning environment. What makes this task especially pertinent is the increasing incidence of autism spectrum disorders, with some evidence suggesting that an estimated 1 in 68 school-aged children have been identified with ASD (Kim et al., 2011).

The fact that we are dealing with two dynamic and highly individualized systems—an individual with ASD and their environment—hampers the study of the already existing environments and the construction of new ones. It may be tempting to apply a reductionist approach, especially since classical science, including psychology, tends to gravitate towards typification (rather than individualization). The same approach is found in the works written by scholars of architecture and design—their methods often follow the modernist paradigm with its preference for solutions based on standardization and economies of scale (Salingaros, 2014). Therefore, an autistic person finds themselves in a situation where their rapidly changing mood and emotional state is in conflict with the qualities of the learning environment determined by a set of formal guidelines and principles. The latter, in their turn, are based on the understanding that the learning environment should have certain obligatory parameters and that these parameters should remain unchanged as well as the reactions of those who occupy this environment. This contradiction impedes the learning progress of children with ASD. It also partially explains the active controversy surrounding the effects of digitalized sociocultural environments that emerged in the 2010s and 2020s on people with ASD.

Hence, the *hypothesis* that this article seeks to test is as follows: in order to create a more autism-friendly environment or in order to assess the "autism-friendliness" of the already existing environment, it is necessary to apply a system of markers that measure its potential effects on ASD individuals' sensory well-being. "Sets" of markers used by a designer or an expert can help create a new positive environment or modify an old environment in such a way that it would have a positive influence on the sensory wellness of a child with ASD.

Thus, taking the concept of sensory well-being as a point of departure, in this paper we aim to identify and describe the test markers that could be used to promote the creation of environments that would be conducive to ASD children's learning and thriving.

## Methodology

The study of sensory issues necessitates an interdisciplinary approach based on the synthesis of psychological and architectural discourses (Alisov, 2009).

In research literature, one of the key concepts in the discussion of learning environments is "enabling physical environment", understood as an environment providing a rich and varied space conducive to exploration (Novoselova, 2001). In her discussion of what constitutes enabling physical environment for children, Novoselova describes different types of "enrichment activities" and identifies those components of such environment that make it conducive to learning (Novoselova, 2001, p. 25).

The ideas of holism, that is, the priority of the whole as opposed to its parts taken separately, is essential to the analysis and expert assessment of the sensory environment of educational establishments. Thus, we adopt a cognitive approach that sees an individual as an integral element of the learning environment: this perspective stresses the environment's influence on people's mental state and thinking rather than the types and results of activities. This study draws from the ideas of sensory integration of A. J. Ayres, who studied the connection between sensory information processing and behavior and education of different categories of children (Ayres, 2005; Bundy & Lane, 2020; Kranowitz, 2005).

The above-described theoretical framework determined the research design, strategies and questions of this study: we analyzed the sensory characteristics of a girl with ASD; we built a sensory "profile" of a typical classroom in a Russian school implementing the so-called adjusted basic education program (ABEP), which makes it suitable for children with ASD.

## Positive Influence of the Environment on Children's Mental Activity

Speaking about the environment as a whole, experts often consider it in a rather narrow sense, e.g., by focusing on social relations or psychological atmosphere (Symaniuk, 2005). To analyze a sensory (un)friendly environment, however, it is necessary to adopt a more comprehensive perspective, considering a diversity of factors.

In the early 19th century, German scholar F. Froebel (1782–1852) developed the concept of kindergarten (literally "children's garden"), which was a novel institution

at that time, and formulated the idea of a connection between the characteristics of the physical environment and children's development. Froebel likened educators to gardeners, seeing their role not only in upbringing but also in creating a good "soil" for children's development. Following the traditions of German humanitarian knowledge, Froebel prioritized the role of the intellectual component in children's development. The "garden" metaphor he uses also accentuates dynamism as a key feature of the learning environment.

The inconsistency inherent in Froebel's approach lies in the fact that he, on the one hand, postulated that the physical properties and elements of the environment should encourage free play and creativity (e.g., "Froebel gifts"—a set of six geometrical 3D toys which can be interacted with), and, on the other hand, he believed that the learning environment should be static—it should be carefully designed and prepared. Froebel's ideas gave rise to many theories and methods, including the methods of M. Montessori (2009), whose classes supported all kinds of children, including children with disabilities. Montessori's idea—to organize the environment which corresponds to the needs of an *active child*—is still relevant today as it connects the processes of perception and learning.

R. Steiner (1861–1925), who was not only an educator but also an architect, came closest to the understanding of the environment as dynamic and, at the same time, structured. He emphasized the psychological comfort of a child that was determined by, first and foremost, the sensory characteristics of the environment. In particular, he designed the Goetheanum, the world centre for the anthroposophical movement (he actually created two buildings—the First Goetheanum, which was destroyed by fire in 1923, and the Second Goetheanum). Steiner's Goetheanum was conceived as a space which activates human thought. Commenting on this building, Steiner highlighted the direct connection between the environment and the human sensory system, indicating that as a creator he did not employ any symbols or other conventional elements but calculated the direct impact of the interior of the building on the human condition.

In the 20$^{th}$ and 21$^{st}$ centuries, the idea of learning environments was developed by representatives of organic architecture (from F. L. Wright to I. Makowitz, M. Budzinski, T. Alberts, S. Calatrava), adaptive architecture (A. Duany, M. Mehaffi, etc.), adherents of the ecological approach (F. Hundertwasser), universal and inclusive design, and sustainable design. Some of them pay more attention to the calculation of desired forms (Fibonacci numbers, "golden ratio", the Sierpiński triangle), others—to their impact on the human condition. It is worth mentioning an interesting and influential idea of the Japanese music teacher S. Suzuki (1898–1998), who raised a whole generation of performers and who believed that the integrity of the environment is a necessary condition for a balanced and versatile development of a human being.

An outstanding project that is worthy of a separate discussion is the 1300-square-foot *Sensory Arts Garden* that was opened in 2017, in Jupiter, Florida, USA, at the Els Center for Excellence by Els for Autism Foundation, hosting programs and services for people with ASD, their parents and therapists (Wagenfeld et al., 2019). The Center is aimed at helping people with ASD realize their potential so that they could lead positive, productive, and satisfying lives. The design of the garden is based on the

interdisciplinary research of designers, educators, psychologists, and musical therapists. In this garden, every detail, the location of plants, materials, furniture, and spaces are carefully considered; its environment balances stimulating and soothing sensory experiences, helping relieve stress and anxiety as well as support all human senses.

Another unique feature of the Sensory Arts Garden is its planting strategy based on the fusion of salutogenic design principles which are health-promoting and indicative of the deep understanding of the needs of people with ASD. The trees were selected based on the structure of branches, the form of the shadow, and visual, olfactory, and tactile characteristics. The planting pattern meets the need for consistency, which is extremely important for people with ASD. Careful plant selection and their location not only ensure security and minimize negative sensory reactions but also allow the staff and family members to discretely observe the children.

Safety and security are the core principles of design, details, and choice of materials for the Garden. Importantly, while keeping the balance of the elements in line with the needs of children with ASD, the Garden's creators also made it appealing to the general public. The Garden gives children an opportunity to feel safe and at the same time to experience being a part of something bigger without getting overwhelmed. Children have an opportunity to find their favorite places in the Garden and go back there every day to interact with these spaces, studying their subtle changes. Moreover, the Garden is a place for outdoor education and thus it meets the needs even of those children who find it difficult to interact with their peers or teachers within the classroom environment. Children can study on their own by using laptops or can do their classwork with a teacher's assistance, including music, yoga, and reading classes. The Garden allows everybody to interact with nature on their own terms and at their own pace. It gives various opportunities for participation; everybody can find something of interest in the Garden.

Thus, as of today, there has been accumulated sufficient amount of evidence that can be used to build a positive environment for people with different needs, including people with disabilities. There is a general consensus that a specially tailored environment can have a positive impact on ASD people's emotional and cognitive development. There is, however, still a perceived lack of specific markers to measure the effects of such environments on sensory well-being.

## Environmental Approach to Creating Sensory-Friendly Environments

The environmental approach of the second half of the 20th and the early 21st centuries may offer us some valuable insights into the environment as a dynamic phenomenon that does not exist outside human perception.

In pedagogy and psychology, environment is understood as a natural or social context or surroundings in which a person operates. Its pedagogical potential is often taken as a given rather than something that needs to be questioned or proven; for example, Rubtsova (2013) mentions "environment as a factor of education". Therefore, for the purpose of our study, we need to turn to the theory of architecture and design,

more specifically, to the environmental approach, which emerged in the early 1970s, at the same time as the study of "atmospherics" (the discipline of designing commercial spaces). In the Russian research literature (Gutnov & Glazychev, 1990; Ikonnikov, 1979; Kaganov, 1999; Zabel'shanskii et al., 1985), the environmental approach is often associated with urban dynamics, that is, the study of the changing elements constituting urban environment. This approach was not implemented in architectural practices (Tatarchenko, 2018, p. 2). The environmental approach has brought to the fore the flexibility, integrity, and dynamism of the environment.

The comprehensive approach proposed by Russian designer and urbanist Vyacheslav Glazychev (1940–2012) is of special interest here: he believed that urban planning should be integrated with the process of active communication with urban communities and specific groups of citizens, resulting in roadmaps, programs, and strategies (Gutnov & Glazychev, 1990). In other words, the core of urban environment is the complex, multi-faceted relationship between the physical environment, its elements, and various groups of citizens.

The comprehensive approach developed by Glazychev enabled urban scholars to transcend the oversimplified interpretations of the environment as a substance or space; the environment came to be understood as "the surroundings mastered by man, transformed by his consciousness and becoming an integral whole with him" (Tatarchenko, 2018, p. 10). The key aspects of the environment that are important for our study are physical, social, psychological, sensory; emotional-psychological, esthetic, and rational properties, which can be targeted separately to achieve the desired pedagogical effects.

While simplistic generalization and reductionism are still the prevalent approaches to the environment, in our view, it would be more productive to see it not as a filled space or substance, but instead to zoom in on those characteristics of the environment that are important for making it autism-friendly.

## Learning Environment Requirements in Russia

Any learning environment is a synthesis of the parameters set by formal policies and guidelines, with individual characteristics, often resulting from spontaneous efforts of the participants in the educational process. Therefore, in order to set the markers of a positive, autism-friendly learning environment, we are going to start with the formal requirements applied to school learning environments in Russia.

The key *technical* requirements regarding the sensory parameters of the educational environment are reflected in the official document entitled *Sanitarno-epidemiologicheskie trebovaniia k organizatsiiam vospitaniia i obucheniia, otdykha i ozdorovleniia detei i molodezhi* [Sanitary-Epidemiological Rules and Regulations for Organizations of Education, Recreation and Wellness for Children and Youth; hereinafter—*Sanitary Rules and Regulations*] (Postanovlenie, 2020). Since humans are inseparable from their environment and the physical parameters of the environment affect people's mental state, the fulfillment of these requirements creates a universal material foundation of any sensory environment. Among other

things, this document specifies the space standards, that is, floor space per child, to prevent cramped classrooms or corridors. These standards, however, do not address those characteristics of school environment that can make it visually overwhelming, fractional, or aggressive (these characteristics are reflected in the markers we are going to describe further in the article).

The requirements regarding school *furniture* in the Sanitary Rules and Regulations are not entirely consistent and deal with different aspects of furniture. For example, it is possible to use multi-functional (transformable) furniture, depending on the size and height of children, their physical development, and whether they have any respiratory, hearing, and visual impairments. The usage of stools and benches instead of chairs is prohibited. The use of color markings on the side exterior surface to indicate the size of furniture is recommended. Color cues can be used to enhance the learning environment, e.g., to designate specific zones, to aid way-findings, etc.

The characteristics of *surfaces* (walls, floors, ceilings, furniture surface materials) are outlined, taking into account the interrelation of the various components of the environment. For example, it is recommended to use finishes which create a matt surface in light shades with strictly defined reflection coefficients from the surfaces. The area of decorative elements with a bright color palette must not exceed 25% of the total wall surface area of the room—but the brightness parameters and specialization of the room are not stipulated.

The Sanitary Rules and Regulations also contain requirements regarding natural and artificial *lighting*: it is required that there should be natural lateral, overhead or two-way lighting, and artificial lighting levels of at least 300 lux in classrooms and 400 lux in workshops. Light fixtures should be equipped with diffusers with the possibility of using fluorescent lamps.

In general, like any instructions or regulations, the Sanitary Rules and Regulations focus on the health and safety of children in an educational setting and provide averaged indicators. They do not take into account the individual sensory characteristics of students, which may to some extent be explained by the modernist methodology and its reductionist approach underpinning these documents. The absence of explanations or references to any scientific sources makes documents of this kind hard to remember. Despite their importance and necessity, they cannot serve as a basis for quick, practical adjustments that would allow an educational institution to create and maintain a healthy sensory environment.

Similar issues apply to the main educational programs. For example, the *Primernaia adaptirovannaia osnovnaia obshcheobrazovatel'naia programma nachal'nogo obshchego obrazovaniia obuchaiushchikhsia s rasstroistvami autisticheskogo spektra* [Adapted Basic Education Program—ABEP] (Primernaia adaptirovannaia, 2015) approaches a learning environment from the didactic perspective, ignoring the technical requirements. This results in certain contradictions between these two documents, making it difficult for schools to develop a consistent strategy of building an environment conducive to children's sensory well-being. The ABEP requires that schools should create an environment that would enable ASD learners to perceive the maximum amount of information from audio-visual sources, which means that there

should be conveniently located and accessible stands with visual materials about in-school rules of conduct, safety rules, timetable, event announcements, etc. There is, however, no requirements concerning the quality of design of these materials, such as fonts and sizes, the proportions and colors used, and so on.

The workspace requirements described in the ABEP also specify that ASD students should be able to choose their own desk and partner. According to the ABEP, ASD children can use special supplements, didactic materials, and workbooks, printed or electronic, contributing to the correction of deficiencies in students' psycho-physical development and helping them make a better general progress. The program provides a long list of games, manuals, objects, and equipment, but no information about their sensory characteristics is provided. It should be noted, however, that such things as "stuffed animals", "accessible musical instruments", and even "a washbasin" can be both neutral for a child with ASD or can have a negative effect on them, if they make the environment incomprehensible and create sensory overloads. The ABEP itself does not contain any guidelines or restrictions of this kind, which in practice leads to the environment becoming cluttered and messy. Paradoxically, things meant to harmonize the learning process may have a negative impact on the learners if these things are not properly organized.

The ABEP does not mention such characteristics as systematicity and coherence of the environment, which can hardly be surprising, since they are not directly related to the Program's objectives. On the practical level, however, it is essential that these characteristics should be ensured, at least, it makes sense to keep out of sight those objects that are not used in the learning process. These items should be kept in containers or drawers in a strictly defined place. It is desirable that these containers should have labels, containing visual and verbal information as to what is inside. The same applies to the walls, which need to be kept free of any visual distractors to avoid bombarding learners with unnecessary information.

If the environment is fractional or chaotic, the child's brain finds itself in a state of multitasking, having to process lots of new (sometimes almost useless) information about all the configurations around it, to decide on the necessary actions: how to avoid an obstacle, how to avoid an unpleasant experience, what to choose as the most preferable option, etc. The effort of rapidly switching from one task to another leads to an increase in dopamine, a biologically active substance that is a neurotransmitter responsible for transmitting signals from the brain to the central nervous system. The body do this through self-regulation (Uchenye vyiasnili, 2022).

Distracting items in the classroom may disrupt learning, making it hard for students to maintain their attention. In other words, in such classroom environment, a child is able to pay only superficial attention to things and phenomena. A good illustration is provided by Figure 1, showing a fragment of a wall in a music classroom with a disparate collection of postcards, some of them overlapping, which disrupts the rhythm in the design and creates a sense of chaos.

For children with ASD and intellectual disabilities, the ABEP recommends to use special textbooks, copy-books, printed workbooks, literacy kits, audio recordings, slides, desktop theater, etc.; however, their sensory characteristics are not specified.

**Figure 1**
*Decoration of a Music Classroom in a School in Yekaterinburg, Russia*

*Note.* Source: T. Yu. Bystrova (2020).

Students with ASD and severe multiple developmental disabilities must be provided with unhindered access to the infrastructure of the general education organization (O sotsial'noi zashchite, 1995) in accordance with the requirements of a barrier-free environment. It is necessary to use special aids and technologies for children with different disabilities, such as individual technical means of movement (wheelchairs, walkers, stand aids, etc.). These objects are never designed as a coherent system. Each of them is usually designed in its own style, color, etc., their proportions and configurations contrast with each other, creating an extra sensory burden.

Special areas are created in the classroom, including areas for recreation and free time. The ABEP specifies that recreation areas should contain the following items: a carpet and/or magnetic boards, flannelgraphs, tactile materials, etc.; there is no mention of the type and sensory characteristics of the objects and materials. Areas for self-care, hygiene procedures should be provided.

The classroom may contain aids for non-verbal (alternative) communication; graphic/printed pictures (thematic sets of photographs, drawings, icons, etc.; these visual materials can be used to create individual communication albums); alphabet boards (tables of letters, cards with printed words for practicing "global reading" comprehension); electronic aids (magnetic-tape recording devices, electronic communicators, a tablet or a personal computer with appropriate software). No specific requirements are set regarding graphics, tactile characteristics, level and features of sound design etc.

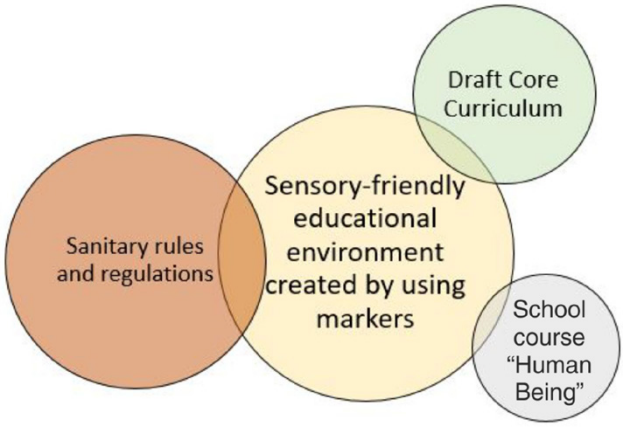
Among the courses offered by schools to children with multiple disabilities, there is the course "Human Being", which is aimed to create a general understanding of the human body and behavior. This course, among other things, includes the information about the senses. It is considered particularly important since it helps enrich the life experience of ASD students, stimulating their positive reactions to the surrounding world.

There is a general consensus among researchers and practitioners working with ASD children about the importance of educational environment: adaptation to the consistently changing environment leads to the improvement of social interaction skills, communication, and adaptability in children with ASD (Khaustov, 2009, p. 1). Khaustov argues that learning space should be adjusted for the functional purpose of the rooms and the nature of specific activities. It is necessary that orientation, communicative and social-behavioral cues and means of communication should be provided. Daily routines should be organized with the help of visual cues; children should always have access to psychological support. Peeters explains how to make not only space but also time more "visual" for ASD children through the use of visual cues, which helps them get answers to the questions about the time of certain events, their duration, ways to perform this or that task, etc. (Peeters, 1997).

Kranowitz describes a strategy for organizing classroom activities to take account of ASD children's sensory characteristics and needs. The author writes about the need to reduce sensory overload (tactile, visual, auditory), but she also suggests using intuition to feel what kind of sensory stimulation disturbs the child (Kranowitz, 2005) and not rely entirely on the results of psycho-diagnostic tests. She also points out the need for comfortable furniture, clean sheets of paper, and a blackboard to improve visual perception of what is written. Kranowitz stresses the importance of having a schedule, prescribed order in the classroom, requirements for organizing the movement of children, and planning breaks in the middle of the lesson and between them.

The "formula" of a sensory-friendly learning environment can be derived by looking at the partial (and rather insignificant) overlap between the requirements found in different normative documents (Figure 2). For example, the Sanitary

**Figure 2**
*Sensory Well-Being Requirements in Legal and Regulatory Documents*




Rules and Regulations and the proposed markers have a common *technical* foundation, but the former document prioritizes the technical aspect while our methodology focuses on the impacts that technical and material objects have on children's sensory well-being. The above-mentioned school course "Human Being" expands children's horizons but the course program provides no flexible methods of evaluating the learning environment (e.g., sets of markets) and has to be supplemented with hands-on guidelines, possibly partially algorithmized. The ABEP provides a general outline of the characteristics of materials and objects and only hint at the possible direction(s) that analysis of a particular educational environment may take. All material and technical support requirements must be focused not only on the child but also on other participants of the educational process in order to make the process more individualized.

Our analysis shows that the legal and regulatory documents recommend the creation of a safe learning environment for children without providing any specific guidelines regarding the sensory aspect of such environment.

An important concept in this respect is sensory well-being, which is underexplored in the Russian segment of the research literature on this topic. In international literature, however, this term is mentioned more frequently but is not always clearly defined (see, for example, Gentil-Gutiérrez et al., 2021; Haigh & Mytton, 2016; Nanda et al., 2019). In this paper, **sensory well-being** is understood as an aggregate indicator of the optimal physical, emotional and psychological condition of an individual. The term "sensory well-being", in our view, can be applied to shed light on the particulars of the six-factor model of psychological well-being (Ryff, 1996). Sensory well-being can be considered within the framework of K. Ryff's environmental mastery. In addition, sensory well-being, like well-being in general, is not a static phenomenon but a dynamic system that tends to change over time.

## Markers of Sensory Well-Being: Overview

Unlike the more stable "properties", "qualities", or "characteristics" of environment, "markers" are understood here as dynamic elements of the environment. A marker is defined as a sign, an indicator of something (Neliubin, 2003). In medicine and psychology, marker is a substance or measurable parameter used to diagnose a particular disorder or condition. A marker is also defined not as a quality but as a *signal which identifies (that is, marks) a function or a quality* (Marker, n.d.). Thus, markers can be also viewed from the semiotic perspective, for instance, a marker is defined as a "sign that serves as a symptom of something" (Zhmurov, 2012).

Since this paper focuses on the relationship between an ASD individual and their environment, we consider it productive to use the term "markers of sensory well-being" to promote a more holistic approach to this problem, based on the understanding that the human body and psyche are not only interconnected but also dynamic (Freud, 1990). The latter is determined by the connection between the components of the human body and mind with the external environment. The possibility of such an interpretation is indirectly supported by the concept "atmospherics" of the environment, introduced in the early 1970s by F. Kotler. This term was initially used in marketing texts to denote one of the factors shaping consumer behavior (Turley & Milliman, 2000). The results of consumer behavior research were considered in later studies on the sensory parameters of design that contribute to people's well-being and productivity (Keeling et al., 2012, p. 8).

Among other things, a more comprehensive view of an autism-friendly learning environment and its characteristics is necessary because of the very nature of autistic spectrum disorders, which have unique manifestations in each particular case. To date, there is no methodological framework that would encompass the multitude of interconnected individual reactions to the environment. What we can do, however, is to stop looking at the environment as a static and abstract construct. In this light, a marker of sensory well-being corresponds to those elements of the environment that contribute to its positive influence on the individual and can be used by experts (but also educators and parents) to evaluate the environment. The flexibility of the proposed methodology stems from the fact that the set of markers can be adjusted for the individual needs of each subject. We believe that in order to evaluate all combinations of all the elements, the use of specialized software and applications is required, which constitutes an avenue for further research.

When designing a sensory safe environment, it is important to take into account universal characteristics such as proportion, scale, and symmetry (Alexander, 1979; Mehaffi, 2022). The role of these characteristics has been discussed in our previous research (see, for example, Bystrova et al., 2019; Bystrova & Tokarskaya, 2022). Therefore, we are going to provide only a brief overview of these parameters. It should be noted that these characteristics can be found not only in artificially created environments but also in any living objects and structures, which is why they have a positive effect on people's mental well-being. These parameters include not only technical and stylistic patterns but may also include features determined by local traditions and culture, landscape, the availability of certain materials, and so on.

The living world and the "living" architectural environment have a complex multilevel structure, where the proportions of objects are arranged in certain numerical sequences (Fibonacci sequence, the "golden ratio") and follow the laws of tectonics. Elements are variable and symmetries lack absolute precision. Perceiving these elements and the relationships between them, the human brain works actively, while cluttered or monotonous environments, on the contrary, drain our cognitive resources. The human sensory system has evolved by tuning itself to connect with other life forms, which means that natural geometry optimizes the state of the body and emotions.

Consequently, the system of markers of sensory well-being includes both general and more specific parameters, that is, those related to the characteristics of a specific person or group of people. This means it is important to personalize and individualize the environment. In other words, each classroom should have its own individual design. Specialists working on the construction of a sensory friendly learning environment should be ready to adjust it to the individual needs of its occupants while keeping the minimum of the basic characteristics required for this type of environment. In this case, it may be concluded that formal requirements and actual markers of a sensory-friendly environment are interconnected and may be used together to create an environment conducive to learning, socialization, communication, etc. As stated above, however, the formal guidelines and requirements do not specify measures of ensuring the consistency of a learning environment, do not set the priorities in the organization of a learning environment, and, finally, they do not take into account the individual characteristics of the environment itself or its components.

In order to *identify the markers of sensory well-being for ASD children,* we suggest the following principles:

• Keep in mind that markers do not provide a one-size-fits-all, universal solutions. What can be good for a short-term stay can be destabilizing when a student stays in the environment for a long time.

• There are no rigid rules regarding the use of markers; a marker can be chosen or adjusted depending on specific goals, purposes and characteristics of the environment.

• A marker is a part of a system, it cannot be considered in isolation from other parameters and markers.

• A considerable role in the assessment is played not by the qualitative values of markers per se but by their ratios, proportions and relationships with each other.

Since repetitive actions, disruptions of social interaction, sensory perception, and communication are characteristic of all children and teenagers with ASD, we can say that the dominant feature of the educational environment for a child with ASD is its *stability*. This means that repeatability, stability, and consistency are its most significant characteristics.

One of the possible avenues for future research could be the development of a set of qualitative indicators to measure those parameters of the learning environment that are crucial for its sensory friendliness. To this end, coordinated work of a multidisciplinary team of specialists will be required.

There are seven main components of the sensory sphere—visual, auditory, tactile, olfactory, gustatory sensations, vestibular sense of balance, and proprioception (the

body's ability to sense action, movement and location) (Heath et al., 2021). For each of them recommendations may be formulated regarding the improvement of the learning environment. Let us look at each of them in more detail.

The *visual aspect* corresponds to the presence of at least three sizes of objects in the environment—large, medium, and small. Through visual perception, humans can also distinguish biomorphic forms, color zoning, rhythmically organized elements and patters. Since fluorescent colors can strain the eyes and be distracting, it is recommended to give preference to natural colors. It also makes sense to use colors and lines to designate specific areas with the classroom space, e.g., the individual study spot for a child with ASD (Figure 3), their space when working at a communal table, etc. Visual contact with nature, for example, in nature corners organized in classrooms is also beneficial for the emotional state of most people (Frumkin, 2003).

**Figure 3**

*Use of Color in a Classroom to Designate an Individual Spot for Each Student*

*Note.* Source: https://educationandbehavior.com/how-to-set-up-the-classroom-for-students-with-autism/

The *auditory* aspect means the absence of objects which make harsh, loud, or scary noises, constantly rustling or humming objects. It is also recommended to wear noise-canceling headphones or listen to music through headphones. The overall level of noise should be reduced and it may also make sense to create a soundproof space (or a room) for privacy. Curtains on the windows can be considered positive markers as long as the children do not manifest any negative reactions to them.

The *tactile* aspect implies that there should be different surfaces and textures in the classroom, including some natural surfaces. It may also be helpful for students to

wear comfortable clothes made of fabric that is non-irritating to the skin. Children can also use weighed sensory aids during classes (knee pads, belts, collars, blankets). Measures should be taken to exclude or reduce the possibility of unwanted tactile contact. When working with children individually, the teacher should avoid towering above students but instead sit or squat to be at the eye-level with them. It is also recommended that children with ASD should be wearing hoodies to prevent sensory overstimulation.

The *olfactory* aspect may include keeping the air fresh, free from any technogenic odors or intense smells.

*Taste sensations* mean that it is important to take into account the child's taste preferences not only in the organization of meals but also in choosing foods to be used as classroom rewards.

*A sense of balance* means the need to create an ergonomically organized, user-friendly workplace: it should be comfortable and encourage a child to keep a good posture and stay focused.

*Proprioception* means that there should be approximately 1-meter distance between classroom occupants. Another positive marker is having vertically oriented images, furniture items, etc. in a classroom.

Educational establishments may also use objects containing water (for example, small pools), access to which will be regulated. Sensory rooms with special equipment and sensory zones in the classroom, such as dry pools, trampolines, and swings, can be used. Creating natural zones with plants which are pleasant to touch (lemon verbena, clerodendrum, soft cacti, etc.) and an opportunity to interact with animals is also beneficial. In addition, to promote inclusion in school, it is important that school counselors, teachers and other staff should provide opportunities for students to meet and get to know each other better.

It should be noted that many children with ASD struggle to filter the sensory input. They can suffer from a “sensory overload”, which makes some types of sensory information unbearable. Sensory overload has both emotional and physical consequences. It can cause anxiety, fear, panic, and the feeling of helplessness, which often lead to disengagement or hysteria. Physically, there may be sensations ranging from a child feeling mildly ill to experiencing unbearable pain. There may be digestive problems, excessive sleepiness, insomnia, and fever.

Signs of sensory overload include nervousness, rapid fatigue, crying, shouting, quick mood swings, trying to “shut off” the overloaded channel (avoidance, turning away, covering ears with hands, etc.), sudden “switching off”, falling asleep. In such cases, it may be necessary to use the so-called “sensory diet”. This term, proposed by Patricia Wilbarger, means a meticulously structured individual plan of activities and procedures which ensure the introduction of sensory stimuli which are necessary for a particular child in order to stay organized during the day taking into account his unique set of needs (Wilbarger & Wilbarger, 2002). On the whole, it is important to modify the environment in such a way so as to eliminate or weaken the triggers (traumatizing stimuli) for people who are in it.

## Discussion

### *Analysis of the Learning Environment at a Russian School and Its Sensory Characteristics*

For our analysis, we chose the learning environment in one of the Russian schools catering for children with ASD and mental retardation. This school is attended by Olga V., whose sensory characteristics are described below. The class may include children aged 12–14. Such difference in age in the same class is due to the fact that parents often delay their children's starting age for school because they believe that extra preparation is necessary.

Looking at the classroom in Figure 4 and its markers, it is impossible to identify the age and condition of those school children who study in it. Not only is the environment unlikely to contribute to their learning progress, but it also probably interferes with their mental activity, especially if we assume that the class includes not only neurotypical children but also children with special needs.

**Figure 4**

*Fragments of the Classroom for Children With ASD*

*Note*. Source: authors.

Let us take a closer look at those aspects of this learning environment that need correction.

*Visual impressions* in this learning environment would in all likelihood be fractional and chaotic as the environment looks overloaded with disparate elements,

some of which are completely unnecessary. In addition, there is no intermediary level between the large and small elements (Tokarev, 2020), which can derail students from concentrating on the tasks at hand. The majority of the objects have matte surfaces, which is good. However, the color combinations are random and far too numerous (e.g., pink walls–orange chairs). Perhaps, the teacher tried subconsciously to compensate for the monotony of the beige interior, which consists predominantly of square and rectangular elements, but did not realize that the excess of color can be overwhelming for her students. No colour cues are used to designate specific zones in the classroom, which makes orientation difficult.

As far as *lighting* is concerned, there is an overlap of natural and artificial light.

As for the *auditory* aspect, the objects in the classroom muffle noises and reduce the volume of the speaker's voice, which should have a positive emotional impact on the learners. However, the noises and rustles of the plastic blinds can be tiring for children.

The *tactile* aspect of the classroom environment also requires some adjustments: there is a lack of natural materials and excess of synthetic materials and surfaces. Unlike synthetic materials such as plastic, natural materials with diverse textures encourage children to observe more closely and stimulate creativity; they are ideal for sensory play. Moreover, a large number of plastic and metal objects create an atmosphere which can be called technogenic and may have undesirable effects on children's *olfactory* systems. On the other hand, the class is regularly aired and there are plants, which partially compensate for the abundance of artificial materials.

No comments can be made regarding the *taste sensations* associated with this classroom.

Children's *sense of balance* may be disturbed by the presence of a big exercise ball on top of the bookshelf (see Figure 4). Moreover, the space has no stable horizontal or vertical lines. The constantly moving vanes of the window blinds may cause a feeling of dizziness in a child.

*Proprioception* can be hindered by many protruding corners (e.g., a cabinet standing next to the blackboard, desks pulled together, etc.). When the teacher and children move around the classroom, for example, during a recess, their routes may overlap, which is not conducive to tactile comfort (Heath et al., 2021, p. 42).

An overview of the key features of the classroom environment shows that the current standards regulating the design of classrooms do not take into account the constantly changing needs of ASD children. In contrast to real-life situations, these standards are underpinned by the idea that the features of the environment and the reactions of its occupants should remain virtually unchanged.

Thus, in order to adapt the classroom environment to the needs of ASD learners, the teacher might be inclined to bring in some new elements and change the configuration of the classroom space but if they lack the necessary expertise to construct a sensory-friendly environment, their efforts might bring some dubious results, e.g., overwhelming or cluttered environment (Koolhaas, 1995).

Therefore, it is necessary to create the standards that would make the teacher (or another professional) entitled to change the environment and create markers of sensory well-being for specific category of students or for individual students.

***The Case of an ASD Student in a Learning Environment***

In order to build a comprehensive understanding of the sensory impacts of the learning environment, we need to keep in mind the integral nature of human perception where all the aspects are inextricably connected with each other. It should, therefore, be emphasized at these point that the proposed division of the environment's properties into seven modalities is tentative and is made for the purposes of this analysis.

In the last decades, there have been some dramatic changes in our understanding of the processes of sensory perception and processing caused by a variety of factors, such as the accelerated pace of life, urbanization, standardization, the spread of mass culture, and the corresponding pragmatic shift in aesthetics.

It should be noted that there are different methodologies to study people's sensory characteristics such as the Sensory Profile (Short Sensory Profile, W. Dunn), Sensory Processing Measure (SPM-2), Sensorimotor History Questionnaire for Parents of Young Children (Kermack), SIPT (Sensory Integration Praxis Test), and some others (see, for example, Bundy & Lane, 2020; Kranowitz, 2005).

This study includes an expert assessment of the sensory profile of a 14-year-old ASD student Olga V. The assessment covered seven modalities and was conducted through the application of the Short Sensory Profile questionnaire developed by W. Dunn. Our goal was to examine the influence of the classroom environment on the student's sensory well-being. We also interviewed the student's parents and educators who worked with her.

**Olga V.** Date of birth: 01.12.2009.

*Visual system:* the child turns lights on and off, likes commercials and brightly colored cartoons with lots of action.

*Auditory system*: the child likes toys that make certain sounds.

*Tactile system:* the child constantly fidgets with something (sticky materials, sand, soft toys, a high pile carpet, brushes); she likes the sensation of being rubbed with hands.

*Olfactory system*: the child sniffs everything she comes across.

*Taste system*: the child adores food with a pronounced taste.

*Vestibular system:* the child is constantly in motion, seeking constant "excitement", she rides on swings, merry-go-rounds, jumps on the trampoline for a very long time.

*Proprioceptive system:* the child stomps frequently, likes to be hugged tightly, massaged, squeezed forcefully; likes to be in confined spaces.

It should be noted that the girl demonstrates hypersensitivity, she is always in "search of sensations" and needs constant stimulation.

***Marker-Based Assessment of the Learning Environment***

By combining the results of our classroom analysis with the girl's data, we developed a personalized set of markers that could be applied to assess how well this environment is suited for this child's individual needs, her learning and leisure activities.

In order to make the environment more positive for her, the following adjustments should be made. First, more muted, calming colors should be used, especially for desks and chairs. It is necessary to get rid of the visual clutter, such as the excessive objects on the teacher's desk or the unnecessary visual materials on the blackboard wall. Closed

blinds (preferably ordinary curtains) are needed for the lesson. The materials used for the lesson can be sufficiently bright to act as stimuli, but they should not contrast with other elements. Natural light or homogeneous warm artificial light should be used, the two types of light should not be mixed because it causes additional sensory stress.

When relaxing, Olga V. is more mobile, she likes moving around the classroom. Therefore, she should be provided with more diverse visual experiences, e.g., at the far wall of the classroom there may be placed toys or books in brighter colors, of different textures and sizes. Classroom zones can be designated with different shades of color (less saturated—more saturated).

The *tactile properties* of surfaces and objects can echo their visual characteristics. What should be avoided is the use of plants with prickly sharp leaves and the excess of artificial materials with uniform smooth surfaces.

As for the *auditory* aspect of the environment, we would recommend to eliminate the monotonous rustling sound of blinds.

*Proprioceptive and vestibular system*. The arbitrary positioning of the teacher's desk and other pieces of furniture means that the classroom lacks a clearly defined structure, which may be disorienting for the ASD child's proprioceptive and vestibular system.

Thus, it can be concluded that the girl's sensory needs are not fully met by the learning environment and that some serious adjustments are needed to make this environment for autism-friendly.

## Results

There is now a growing awareness of the need for a more personalized, flexible learning environment to foster each individual child's interests and strengths. Such environments can be approached from a variety of perspectives—medical, architectural, engineering, pedagogical, ergonomic and so on. As today's schools are becoming more inclusive and there is a diversity of forms of learning to choose from, learning environments are becoming more complex. The situation is even more challenging if we are dealing with the needs of a child with autism spectrum disorder, for whom certain sounds, textures, smells and types of light can be overwhelming.

Digitalization makes the problem even harder. Augmented reality tools or constant switching between online and offline modes of learning make schools and parents practically incapable of considering all the characteristics of objects and environments used in the process of education. To address this problem, we need not only to create new objects but also, more importantly, to rethink, reconfigure and adjust the characteristics of the already existing ones. The principles of systemic design, which were developed over half a century ago and are still relevant today, can help make learning environments more sensory-friendly.

In our analysis of the theory and practice of creating sensory-friendly environments, we have shown that the necessary balance of all elements can be achieved only if there is a comprehensive, rational and dynamic vision of such an environment. Creation of a more individualized learning environment requires the adaptation of the current Sanitary Rules and Regulations to encompass learners' sensory needs.

Due to the absence of a comprehensive study on this topic, we used the data provided by the *Vserossiiskii nauchno-issledovatel'skii institut tekhnicheskoi estetiki* (All-Russian Scientific Research Institute of Industrial Design—VNIITE)—the chief Russian design research institute—and the Massachusetts Institute of Technology (MIT). We also used the evidence provided by specialists involved in designing sensory-safe environments in museums (Hoskin et al., 2020; Magkafa, 2022; Steinberg et al., 2022); by the Russian design company Art.Lebedev Studio. Their findings were adapted to the reality of modern Russian schools, which allowed us to formulate a set of recommendations for making learning environments more sensory friendly.

The concept of sensory well-being and its markers may provide some valuable insights into what constitutes sensory friendly learning environment and ways to adjust a learning environment to the specific needs of students and groups of students.

## Conclusion

This article raises the question of how a learning environment contributing to ASD children's sensory well-being (that is, a sensory safe environment) can be organized. ASD learners have specific sensory needs, which often hinder not only effective learning but also their social adaptation in general. The effectiveness of education for this category of children will be higher in a sensory safe environment. Such environment can be seen as part of an autism-friendly environment (Autizm. Druzheliubnaia sreda, 2016) and will help improve their motivation to learn.

The proposed marker method can be used for an individualized assessment of the sensory characteristics of a learning environment, its autism-friendliness, and the possibility of adjusting a learning environment to ASD students' sensory needs.

The sensory characteristics of a learning environment should not be seen as a given but rather as something that is continuously changing and can be altered if necessary. It is also important that people responsible for constructing and maintaining the learning environment should have enough expertise to adjust it to the individual needs of students and to the goals of the learning process. This, in its turn, creates the need to raise the awareness of this problem among the educators and other specialists, but, unfortunately, so far, no such efforts have been undertaken.

A promising avenue for further research could be to develop a model that could be used by architects, designers and educators to create a sensory safe educational space based on the proposed set of markers. The proposed approach can be relevant not only for learning environments for children with ASD but also for normatively developing children as well as for constructing sensory safe environments for more general purposes.

## References

Alexander, Ch. (1979). *The timeless way of building.* Oxford University Press.

Alisov, E. A. (2009). Psikhologo-pedagogicheskie aspekty sensornogo mirovospriiatiia lichnosti [Psychological-pedagogical aspects of human world perception]. *Psychological-Educational Studies*, *1*(1).

*Autizm. Druzheliubnaia sreda: Kak adaptirovat' prostranstvo muzeia dlia liudei s autizmom i ikh semei* [Autism. Friendly environment: How to adapt the museum space to the needs of people with autism and their families]. (2016). Fond sodeistviia resheniiu problem autizma "Vykhod".

Ayres, A. J. (2005). *Sensory integration and the child* (25th anniversary ed.). Western Psychological Services.

Bundy, A. C., & Lane, S. J. (2020). *Sensory integration: Theory and practice* (3rd ed.). F. A. Davis Company.

Bystrova, T. Yu., & Tokarskaya, L. V. (2022). Inkliuzivnyi dizain razvivaiushchikh igrushek: Opyt realizatsii podkhoda [Inclusive design of educational toys: Experience in implementing the approach]. *Akademicheskij vestnik URALNIIPROEKT RAASN*, 1, 78–83. https://doi.org/10.25628/UNIIP.2022.52.1.013

Bystrova, T. Yu, Tokarskaya, L. V., & Vukovic, D. B. (2019). Optimum virtual environment for solving cognitive tasks by individuals with autism spectrum disorders: The questions and methods of design. *International Journal of Cognitive Research in Science, Engineering and Education*, *7*(1), 63–72. https://doi.org/10.5937/IJCRSEE1901063B

Fernández-Andrés, M. I., Pastor-Cerezuela, G., Sanz-Cervera, P., & Tárraga-Mínguez, R. (2015). A comparative study of sensory processing in children with and without autism spectrum disorder in the home and classroom environments. *Research in Developmental Disabilities*, *38*, 202–212. https://doi.org/10.1016/j.ridd.2014.12.034

Freud, S. (1990). *Jokes and their relation to the unconscious* (J. Strachey, Trans.). Norton. (Originally published in German 1905)

Frumkin, H. (2003). Healthy places: Exploring the evidence. *American Journal of Public Health*, *93*(9), 1451–1456. https://doi.org/10.2105/ajph.93.9.1451

Gentil-Gutiérrez, A., Cuesta-Gómez, J. L., Rodríguez-Fernández, P., & González-Bernal, J. J. (2021). Implication of the sensory environment in children with autism spectrum disorder: Perspectives from school. *International Journal of Environmental Research and Public Health*, *18*(14), Article 7670. https://doi.org/10.3390/ijerph18147670

Gutnov, A. E., & Glazychev, V. L. (1990). *Mir arkhitektury: Litso goroda* [The world of architecture: The face of the city]. Molodaya gvardiya.

Haigh, J., & Mytton, C. (2016). Sensory interventions to support the well-being of people with dementia: A critical review. *British Journal of Occupational Therapy*, *79*(2), 120–126. https://doi.org/10.1177/0308022615598996

Happé, F. (1994). *Autism: An introduction to psychological theory* (1st ed.). Psychology Press. https://doi.org/10.4324/9780203014226

Heath, O., Jackson, V., & Goode, E. (2021). *Creating positive spaces by designing for cognitive and sensory well-being*. Interface.

Hoskin, E., Singh, A., Oddy, N., Jessup Schneider, A. L., Trepanier, G., Trudel, Ch., & Girouard, A. (2020). Assessing the experience of people with autism at the Canada science and technology museum. In *CHI EA '20: Extended Abstracts of*

*the 2020 CHI Conference on Human Factors in Computing Systems, Honolulu, USA, April 25–30, 2020* (pp. 1–7). Association for Computing Machinery. https://doi.org/10.1145/3334480.3382834

Ikonnikov, A. V. (1979). *Arkhitekturnyi ansambl'* [Architectural ensemble]. Znanie.

Kaganov, G. Z. (1999). *Obrazy gorodskoi sredy v massovom soznanii i v iskusstve* [Representations of the urban environment in mass consciousness and art] (Unpublished doctoral dissertation abstract). Nauchno-issledovatel'skii institut teorii arkhitektury i gradostroitel'stva.

Keeling, T., Clements-Croome, D., Luck, R., & Pointer, Ph. (2012). A review of how sensory design can influence well-being and productivity. In *Proceedings of the CIBSE ASHRAE Technical Symposium, Imperial College, London, UK, April 18–19, 2012.*

Khaustov, A. V. (2009). Organizatsiia okruzhaiushchei sredy dlia sotsializatsii i razvitiia kommunikatsii u detei s rasstroistvami autisticheskogo spektra [Organization of the environment for socialization and development of communication skills of children with autistic spectrum disorders]. *Autizm i narusheniia razvitiia*, *7*(1), 1–12.

Kim, Y. S., Leventhal, B. L., Koh, Y.-J., Fombonne, E., Laska, E., Lim, E.-C., Cheon, K.-A., Kim, S.-J., Kim, Y.-K., Lee, H. K., Song, D.-H., & Grinker, R. R. (2011). Prevalence of autism spectrum disorders in a total population sample. *American Journal of Psychiatry*, *168*(9), 904–912. https://doi.org/10.1176/appi.ajp.2011.10101532

Koolhaas, R. (1995). Bigness, or the problem of Large. In J. Sigler (Ed.), *S, M, L, XL: Small, Medium, Large, Extra Large*. The Monacelli Press.

Kranowitz, C. S. (2005). *The out-of-sync child: Recognizing and coping with sensory processing disorder*. Skylight Press.

Magkafa, D. (2022). *Exploring the design, development and evaluation of an app for autistic children in a museum setting* [Doctoral dissertation, University of the West of England]. University of West of England. EThOS. https://ethos.bl.uk/OrderDetails.do?uin=uk.bl.ethos.861055

Marker. (n.d.). In *SLOVARonline*. https://809.slovaronline.com/3463-%D0%BC%D0%B0%D1%80%D0%BA%D0%B5%D1%80

Mehaffi, M. (2022, March 22). *Why Christopher Alexander still matters*. Planetizen. https://www.planetizen.com/features/116600-why-christopher-alexander-still-matters

Montesorri, M. (2009). *The Montessori method.* Wilder Publications.

Morozov, S. A. (2014). *Osnovy diagnostiki i korrektsii rasstroistv autisticheskogo spektra* [Basics of diagnostics and intervention for autism spectrum disorders]. Dobryj vek.

Nanda, U., Adams, L., & Hoelting, M. (2019, April 29). *Sensory well-being for adolescents with developmental disabilities: Creating (and testing) a sensory well-being hub.* HKS. https://www.hksinc.com/how-we-think/reports/sensory-well-being-for-adolescents-with-developmental-disabilities-creating-and-testing-a-sensory-well-being-hub/#download

Neliubin, L. L. (2003). *Tolkovyi perevodovedcheskii slovar'* [Explanatory translation dictionary]. Nauka.

Novoselova, S. L. (2001). *Razvivaiushchaia predmetnaia sreda* [Conducive learning environment]. Tsentr "Doshkol'noe detstvo".

*O sotsial'noi zashchite invalidov v Rossiiskoi Federatsii* [On social protection of persons with disabilities in the Russian Federation]. Federal Law of the Russian Federation No. 181-FZ. (1995, November 24). http://pravo.gov.ru/proxy/ips/?docbody&nd=102038362

Peeters, T. (1997). *Autism: From theoretical understanding to educational intervention*. Wiley.

*Postanovlenie Glavnogo gosudarstvennogo sanitarnogo vracha Rossiiskoi Federatsii № 28* [Decree of the Chief Public Health Officer of the Russian Federation No. 28]. (2020, September 28). http://publication.pravo.gov.ru/Document/View/0001202012210122

*Primernaia adaptirovannaia osnovnaia obshcheobrazovatel'naia programma nachal'nogo obshchego obrazovaniia obuchaiushchikhsia s rasstroistvami autisticheskogo spektra* [Sample adapted basic general education program of primary general education for students with autism spectrum disorders]. (2015). https://fgosreestr.ru/poop/primernaya-adaptirovannaya-osnovnaya-obshheobrazovatelnaya-programma-nachalnogo-obshhego-obrazovaniya-obuchayushhixsya-s-rasstrojstvami-autistich-eskogo-spektra

Rubtsova, O. B. (2013). *Sredovoi podkhod k postroeniiu vospitatel'nogo protsessa professional'nogo litseia* [Environment-focused approach to constructing of the learning process in a professional lyceum] (Unpublished master's thesis). Vysshaia shkola narodnykh iskusstv (institut).

Ryff, C. D. (1996). Psychological well-being. In J. E. Birren (Ed.), *Encyclopedia of gerontology: age, aging, and the aged* (Vol. 2). Academic Press.

Salingaros, N. A. (2014). *Twelve lectures on architecture: Algorithmic sustainable design*. Sustasis Press.

Steinberg, A. S., Voskov, A. L., & Klevtsova, E. M. (2022). Sotsiokul'turnaia integratsiia vzroslykh liudei s autizmom v ramkakh proekta "12MM!" [Sociocultural integration of adults with autism in the "12MM!" project]. *Autizm i narusheniia razvitiia*, *20*(2), 36–42. https://doi.org/10.17759/autdd.2022200205

Symaniuk, E. E. (2005). *Psikhologicheskaia bezopasnost' obrazovatel'noi sredy* [Psychological safety of the learning environment]. Ural State University.

Tatarchenko, A. V. (2018). *Sredovoi podkhod v formirovanii arkhitektury tsentra Moskvy (kontse XX – nachale XXI v.)* [Environment-focused approach to the formation of architecture in the centre of Moscow (late 20th–early 21st century)] (Scientific report on the main results of the thesis). Moscow Institute of Architecture.

Tokarev, N. *Arkhitektura priamogo deistviia* [Direct action architecture]. Proekt Rossiia. https://prorus.ru/interviews/arhitektura-pryamogo-dejstviya/

Turley, L. W., & Milliman, R. E. (2000). Atmospheric effects on shopping behavior: A review of the experimental evidence. *Journal of Business Research*, *49*(2), 193–211. https://doi.org/10.1016/S0148-2963(99)00010-7

*Uchenye vyiasnili, kak kletki mozga vydeliaiut gormon udovol'stviia* [Scientists have found out how brain cells release the hormone of pleasure]. (2022, February 15). RIA Novosti. https://ria.ru/20210406/dofamin-1727063233.html

Wagenfeld, A., Sotelo, M., & Kamp, D. (2019). Designing an impactful sensory garden for children and youth with autism spectrum disorder. *Children, Youth and Environments*, *29*(1), 137–152.

Wilbarger, J., & Wilbarger, P. (2002). Clinical application of the sensory diet. In A. C. Bundy, S. J. Lane & E. A. Murray (Eds.), *Sensory integration: Theory and practice* (2nd ed., pp. 339–341). F.A. Davis.

Zabel'shanskii, G. B., Minervin, G. B., Rappaport, A. G., & Somov, G. Iu. (1985). *Arkhitektura i emotsional'nyi mir cheloveka* [Architecture and the emotional world of man]. Stroiizdat.

Zhmurov, V. A. (2012). *Bol'shaia entsiklopediia po psikhiatrii* [Great encyclopedia of psychiatry] (2nd ed.). Dzhangar.