



Julia Pogoda*, Joanna Majczyk**

Educational spaces for students with autism spectrum disorders

Introduction and state of research

Schools are basic educational and care institutions in every community – they are a meeting place, a place to gain knowledge, and often they are a local centre also for people not related to them. Their main function, however, is education and preparation of children to function in society. One of the determinants of the education process is the way in which a specific school building is designed. In a well-formed space, not only is it easier to assimilate knowledge, but also the level of well-being of students and the ability to interact and build relationships increases. Given the huge role that schools play in human development, it is crucial to ensure that buildings in which they are located provide equal opportunities to every user. This is of particular importance for children with autism spectrum disorders – an appropriate environment can significantly support the therapeutic process and affect their functioning later in life [1].

The conditions prevailing in the overwhelming number of Polish schools and kindergartens make it difficult, and in some cases completely prevent children with autism spectrum disorders from education on an equal basis. The main problems occurring in this type of institutions are: inadequate lighting, wrong choice of colours, lack of zoning and their appropriate marking. Often, the classroom equipment is also not adapted to the different needs of its users. The inspections carried out in 2019 showed that publicly accessible schools educating students with autism [...] *struggled with space difficulties, rarely had the opportunity to allocate special rooms for revalidation or*

so-called quiet areas [2, p. 11]¹. Limiting distracting stimuli, as well as creating places to isolate from excess stimulants allows children to concentrate on their activities for a longer time, increases independence and a sense of security. In today's world saturated with sensory stimuli, it is also justified to introduce similar solutions in workplaces, public facilities, as well as on an urban scale.

A pioneer in research on design for people with autism spectrum disorders is Magda Mostafa, who for over 20 years has been describing the relationship between the functioning of autistic people and the space they live in [3], [4]. So far, she has developed numerous designs and guides, but most of all she has created a set of principles supporting inclusive design (ASPECTSS™) [4]. Referring to the research of psychiatrists, Mostafa defined the essence of design for people with autism spectrum disorders, which is the control of the user-sensory environment relationship with its sounds, textures, patterns, shapes and chiaroscuro [3, p. 144]. Later research focused on the individual discussion of “sensory phenomena”, paying attention, among others, to the need for special lighting design [5], as well as a conscious selection of finishing materials [6]. It was found that students with ASDs feel safe and stable in buildings with a simple, orderly and predictable interior layout [7].

Based on the seven recommendations of Mostafa (acoustics, spatial sequencing, escape space, compartmentalization, transition space, sensor zoning, safety [3]), in 2019 American scientists developed detailed guidelines for the design of vocational centres for people with autism spectrum disorders. It was also noted that the Americans with Disabilities Act defines the standards of construction accessible to people with limited physical abilities, but it is

* ORCID: 0000-0001-8131-6231. Faculty of Architecture, Wrocław University of Science and Technology, Poland.

** ORCID: 0000-0002-7660-3161. Faculty of Architecture, Wrocław University of Science and Technology, Poland, e-mail: joanna.majczyk@pwr.edu.pl

¹ It is worth noting that architectural solutions used to minimize the effects related to sensory integration problems do not adversely affect children with no autism spectrum disorders, and may have a positive impact on their functioning.

not a sufficient indicator for design for people with autism spectrum disorders [8]. Based on, among others, the above-mentioned recommendations, Tomasz Bojęć, Joanna Erbel and Marta Wierusz discussed the basic principles of design for people with emotional and/or developmental disorders, such as autism, ADHD or dyslexia [9]. In 2017, Keith McAllister and Sean Sloan described experimental workshops where children with ASDs consulted school designs. As a result, school rooms were grouped in a non-standard way, however, increasing the sense of security and comfort of sensory-sensitive children [10]. In Poland, there are no publications on the design of educational institutions for children with autism spectrum disorders, but the topic is taken up during architectural studies, as reported by, for example, Maria Bielak-Zasadzka and Agnieszka Bugno-Janik from the Silesian University of Technology [11].

Autism spectrum

Autism, often mistakenly called a disease, is a holistic developmental disorder according to the ICD-10 international classification. We can distinguish childhood autism, which is diagnosed up to the age of three, atypical autism – if the symptoms appear later, and Asperger's syndrome, when there are no speech disorders [12]. The newer classification, ICD-11, refers to autism spectrum disorders [13]. The aforementioned types of disorders are listed on the scale depending on the severity of symptoms, but they do not have separate names. This classification method highlights how diverse the autistic community is. There are highly functioning people, often with above-average IQ, but also people with serious difficulties in communication and independent functioning [14, p. 13]. Each of these people needs a different degree of support.

Although the disorder has different degrees of severity, which of course differentiates the symptoms, there are features that characterize people with autism spectrum disorders. One of them is the difficulty in recognizing emotions [15], although, contrary to popular belief, it is not a total inability – most autistic people are able to read simple emotions, such as sadness. The problem begins with more complex emotions such as irritation or sarcasm. Confusion can also be caused by subtle gestures – for example, a blink of an eye or a wry face. Some people with autism, however, are able to learn to recognize ways of expressing emotions, it is simply not a natural skill for them as it is for neurotypical people.

Another characteristic sign of autism is a greater interest in inanimate objects than in humans [16]. It is often possible to observe children with autism spectrum disorders arranging objects in a tower or in a linear arrangement, which is caused by their perceived need for repeatability and predictability [17]. Children may not feel the difference when the people around them change (e.g. when the class is taken over by another teacher), but it is very likely that a change in the schedule of activities to which they are accustomed will cause anxiety or anger.

Another factor influencing the functioning of people with autism spectrum disorders is high sensitivity to sensory stimuli. Each impulse coming from the environment

is perceived more clearly and more intensely, and with the simultaneous lack of the ability to selectively perceive them, functioning in public spaces becomes a huge challenge. Children with autism often perceive sounds more clearly, although sometimes they do not react to them at all. In the past, they were often misdiagnosed as deaf for this reason [18]. Instead, they are able to pick up very soft sounds that are ignored by neurotypical people. They also have a specific texture preference, which applies to the items that surround them. Smooth surfaces resembling natural textures are usually perceived as pleasant. Research published in 2012 also showed that in the case of textures classified as pleasant or neutral, subsequent exposure causes a similar reaction, but in the case of further contact with the texture indicated by the participants of the study as unpleasant, the negative reaction intensifies [19]. People with autism spectrum disorders are often unable to ignore stimuli from the environment, such as flashing lights, fan noise or other reverberations, which often lead to over-stimulation, which in turn leads to strong emotions or panic attacks in children. In such situations, it is important to first try to prevent them by providing a place without excess stimulants where the child can hide, and to provide a space for safe emotional discharge once overexposure to external factors has occurred. In an environment full of stimulants and not providing safe hideouts, such as schools that are not adapted to people with autism spectrum disorders, it is difficult for a child to stay focused, which exacerbates the differences between neurotypical and autistic children.

Design for autistic people

Autism has so far been a misunderstood disorder and although it affects an estimated 1 in 100 people in Europe [2], it is still not included in accessibility regulations. Adapting designs to autistic people is not a common practice, and there are relatively few specialists conducting research on this topic. While taking into account the needs of people with physical disabilities in architectural and urban designs, especially in public facilities, is now obvious – thanks to clearly defined requirements – there is still no similar awareness or official guidelines for autism-friendly design. Autism is a spectrum, so formulating design principles is not an easy task, but it is worth the effort, because introducing appropriate solutions can significantly affect the functioning of people affected by this disorder [2].

There are two main trends in designing for people with autism spectrum disorders. The first one is the neurotypical approach, which is based on the weakened generalization ability² in autistic people [20]. The design assumptions are based on the hypothesis that people with autism spectrum disorders staying in spaces with a significantly limited amount of sensory stimuli will not be able to apply the skills

² Generalization of a stimulus is a phenomenon in which a reaction conditioned on an experimental stimulus also manifests itself in relation to many other stimuli present in the environment; reaction to similar stimuli in the same way; the strength of the reaction is determined by the similarity of stimuli (generalization gradient).

acquired there to other spaces. This is particularly important in the case of educational facilities, where we assimilate the most knowledge, also practical knowledge, and shape habits. Schools designed in the neurotypical trend are to map places and create situations with which autistic children may come into contact outside the institution.

An example of a facility designed according to a neurotypical approach is the Morris-Union Jointure Commission's Developmental Learning Center by USA Architects in Warren, near New York [21]. The main school corridor imitates a typical busy street, full of service premises, among which you can find a bank, shops (Fig. 1), as well as a number of different types of public toilets. Learning everyday activities is an essential element of therapy, but it is hard to resist the impression that a mock-up of city life in the school building may make it difficult to concentrate and introduce unnecessary confusion. Opponents of this trend are of a similar opinion, and among the disadvantages of this method, they also list the multitude of colours and textures, a hazy functional system or, paradoxically, hindering the generalization of the function that the school performs [23]. What is more, the interior design follows the style of postmodernism, with eclecticism, accumulation of random forms, as well as a certain exaggeration difficult to perceive for children with autism spectrum disorders written into its genetic code.

Another project mapping the neurotypical environment is Celebrate the Children School in Denville, USA. As an integrated school, it has facilities for disabled people, but it also deliberately duplicates many solutions from public schools. Such behaviour is again argued with the need to improve generalization and adaptation of children to function at universities and at work. Analysing the functioning of kindergartens and public schools, it can be observed that many of them do not provide sufficient conditions, even for neurotypical children [24] – inadequate acoustics or lighting in classrooms significantly impede the acquisition of knowledge. Therefore, when designing in the neurotypical trend, one has to make a choice whether one wants to reproduce the averaged existing environments or an ideal, model school. In the first case, a not entirely friendly learning environment is created for children, but similar to the one where they will end up after completing their education. In the second version, generalization is made difficult as most schools do not meet the model standards. The key question to be asked is: should children with disabilities be taught to adapt to inappropriate conditions, or should they be able to use spaces that are comfortable and inclusive at every stage of their lives?

The second trend in designing for children with autism spectrum disorders differs from the neurotypical approach and takes into account their high sensory sensitivity with particular care. The concepts of this trend create sensory differentiated spaces that enable the gradual development of adaptive skills of children with autism. An example of the implementation of an educational institution in the sensory design trend is the Pond Meadows integrated school in Guildford, Great Britain, designed by DSDHA (Fig. 2). It is a single-story building, which significantly reduces the number of architectural barriers. Spatial se-



Fig. 1. Warren/NJ, USA, Morris-Union Jointure Commission's DLC school corridor (designed by USA Architects) (photo by R. Faulkner, source: [22])

Il. 1. Warren/NJ, USA, korytarz szkoły Morris-Union Jointure Commission's DLC (proj. USA Architects) (fot. R. Faulkner, źródło: [22])

quencing is clearly visible – the school consists of three parts, differing in the number of sensory stimuli – ranging from the generally accessible common part to classrooms requiring concentration, which are additionally arranged according to age categories. Each of the zones is organized around an internal courtyard, which provides additional lighting for the school, but can also act as a hideout. Hideouts constitute an essential part of any autism-friendly space – they are places to rest from excess stimuli. Like the transition zone, which connects spheres with different levels of limitation of sensory factors, hideouts should remain sensory-neutral. It is also recommended to diversify them so that they can be a place of isolation, but also of group interactions in a safe space. Green courtyards introduce vegetation to the interior of the school and allow for self-stimulation – observing the shadows cast by plants or touching their textures. The classrooms are located along the outer perimeter of the building, which allows for the optimization of access to natural light and ventilation, as well as direct access to safe outdoor spaces, constituting a potential hideout. The alternately falling and rising shape of the roof affects the acoustic comfort in the building and the differentiation of room heights – those with a lower height are characterized by a limited number of stimuli.



Fig. 2. Guildford, Great Britain, Pond Meadows school:
 a) ground level layout (©DSDHA, source: [25]),
 b) inside corridor (photo by ©Timothy Soar),
 c) entry zone (photo by ©Timothy Soar), d) sectional view (designed by ©DSDHA, source: [25])

II. 2. Guildford, Wielka Brytania, szkoła Pond Meadow:
 a) rzut przyziemia (©DSDHA, źródło: [25]),
 b) korytarz wewnętrzny (fot. ©Timothy Soar),
 c) strefa wejściowa (fot. ©Timothy Soar), d) przekrój poprzeczny (proj. ©DSDHA, źródło: [25])

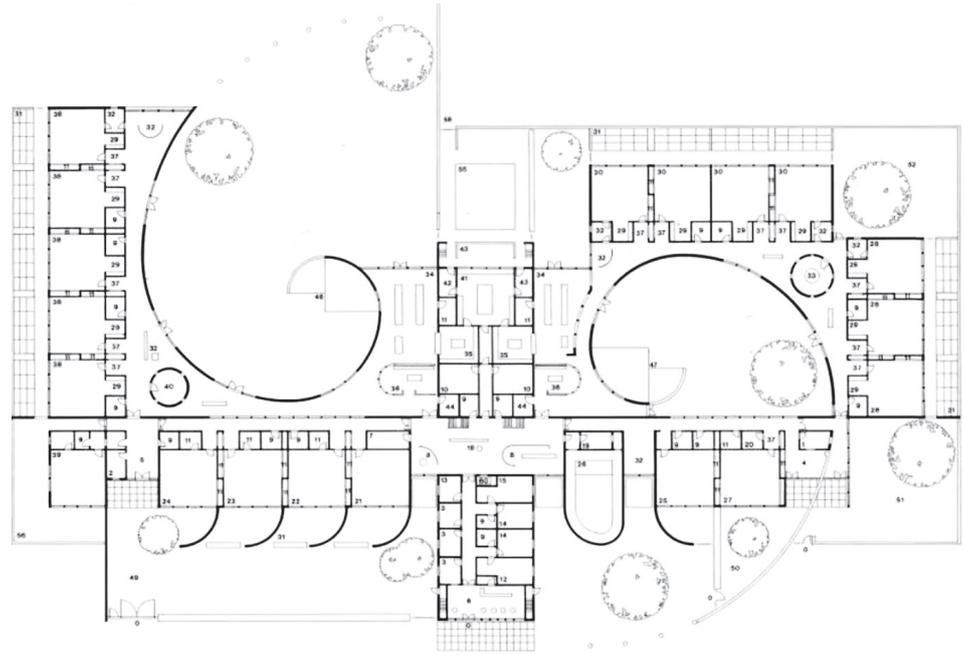


Fig. 3. Newcastle, Great Britain, Thomas Bewick School (designed by S. Humphreys, source: [26])

Il. 3. Newcastle, Wielka Brytania, szkoła Thomas Bewick (proj. S. Humphreys, źródło: [26])

When describing the sensory approach, it is worth presenting the work of Simon Humphreys. The British architect has designed many specialized facilities for autistic people. One of them is the Thomas Bewick School in Newcastle (Fig. 3).

In addition to the previously discussed guidelines resulting indirectly from the principles of universal design, Humphreys emphasizes proportion and proxemics, introducing, among others, the golden ratio in his designs. This solution helps maintain harmony and a sense of order, as well as repeatability, which is desired by people with autism spectrum disorders. On the other hand, rounded “spiral” walls are designed to soften the corners and ensure smooth transitions between spaces and safe communication. The school’s corridors, situated around internal courtyards, allow for a permanent, external point of reference that facilitates locating oneself in the building. The invariable features of his designs include moderation in the choice of colours, arrangement of hideouts and special care for acoustic conditions. The architect also supports the introduction of a large amount of natural light into the rooms, but stipulates the need to diffuse it in order to avoid excessive contrasts [27].

Due to the difficulties in social interactions, spaces for autistic people should be relatively large so that it is possible to maintain physical distance, while also maintaining comfortable acoustic conditions. In the case of schools, it is reasonable to design space in such a way as to enable discreet supervision, not disrupting the functioning of users.

Both the neurotypical approach and the sensory approach are based on a comprehensive analysis of the needs of people with autism spectrum disorders. Both approaches, apart from clear values, also have disadvantages. Nevertheless, in recent years there has been a significant increase in interest in autism-friendly architecture. Further research may include the development of existing trends, their synthesis or the development of a completely different approach.

Examples of solutions for educational facilities for autistic children in Poland

In the 1980s, when autism diagnostics was only started in Poland, the statistics showed the occurrence of this disorder in 2–4 per 10,000 people. Currently, we can observe the so-called autism epidemic – an increasing number of people are diagnosed with autism spectrum disorders each year. At the moment, the disorder occurs in 1 in 100 people [2]. Despite various theories concerning the increase, it is mainly due to a change in diagnostic criteria. Until now, the ICD-10 International Classification of Diseases and Health Problems was in force in Poland, but in 2022 a new ICD-11 classification system was introduced, which includes many important changes, such as, for example, resignation from the division into childhood autism, atypical autism and Asperger’s syndrome. Instead, an autism spectrum disorder is diagnosed, perceiving autism as a continuum, taking into account different levels of severity [28]. This system has been functioning in the United States for many years. It can be expected that in Poland it will become popular in medical practice in two-three years.

Cognitive, social and communication abilities of people with autism spectrum disorders are varied, and therefore their education can take place in mainstream, integrated or special needs school. Research shows that after completing education, people with autism who are within the intellectual norm are able to achieve independence [29]. Numerous problems in the education system of autistic people hinder this process. These include, among others, the lack of a procedural curriculum, shortage of staff and their insufficient qualifications [30]. Persons with autism spectrum disorders are not provided with continuity of support – the continuation of education at a later stage is difficult due to the lack of integrated secondary schools and the non-adaptation of those generally available to students with autism. Another obstacle for children with

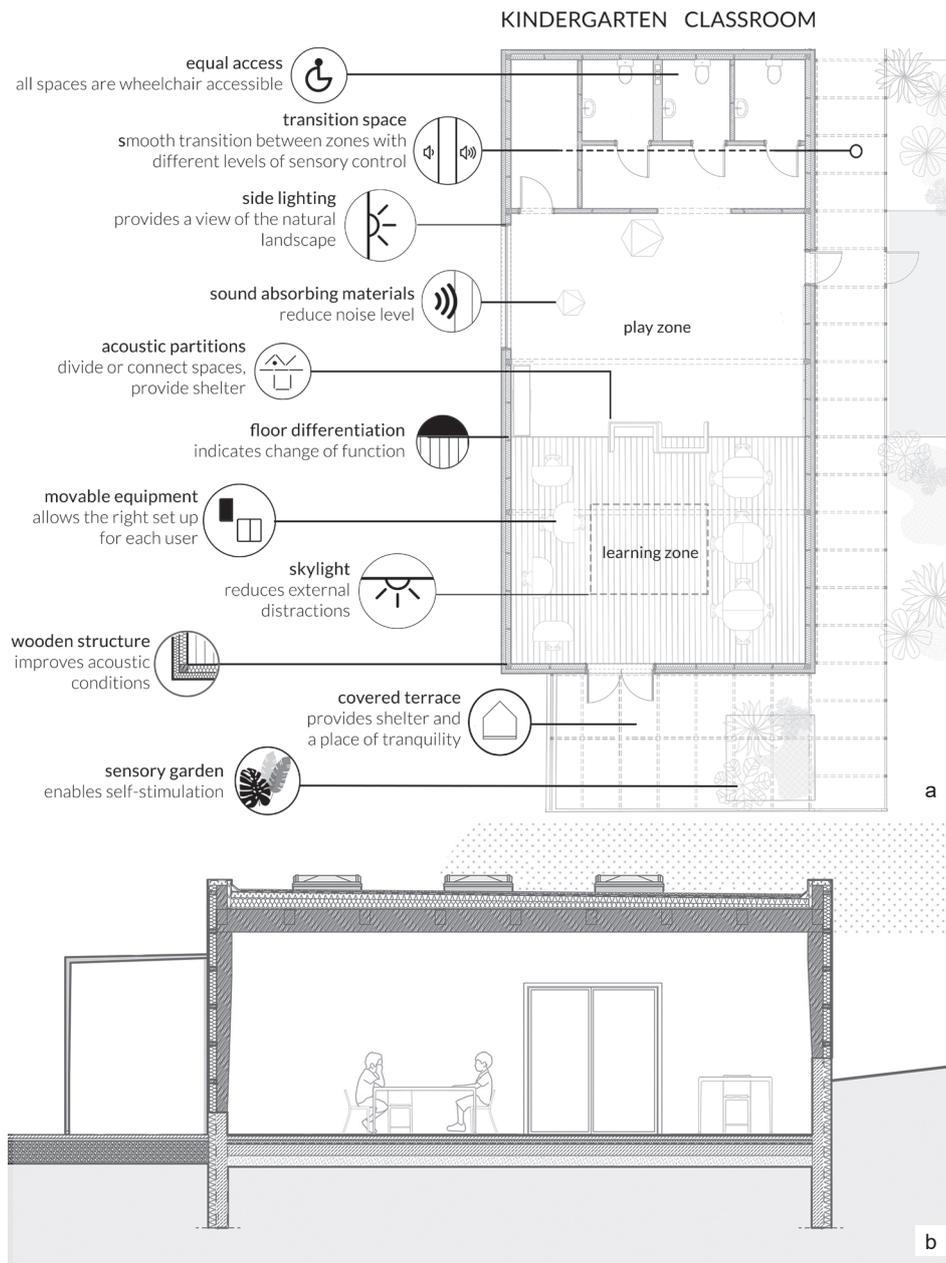


Fig. 4. Diagram showing the classroom adapted to children with autism spectrum disorders: a) layout, b) sectional view (designed and drawn by J. Pogoda)

Il. 4. Schemat przedstawiający klasę lekcyjną dostosowaną do dzieci w spektrum autyzmu: a) rzut, b) przekrój (proj. i rys. J. Pogoda)

autism spectrum disorders and their parents is the shortage of specialized facilities, difficult access to those already existing (locations in selected large cities, queues for diagnosticians and therapists) and social barriers.

Education of children with autism requires adapting the environment and working methods to their needs, therefore, for each child with an autism spectrum disorder the highest educational subsidy is granted – 9.5 times greater than the amount of the educational standard, i.e. about PLN 6,000 per month. Nevertheless, a significant part of the schools audited by the Supreme Audit Office in 2019 did not fully take advantage of the possibilities to support students with autism [2].

Spatial exclusion is a common problem of public schools, however, high sensory sensitivity of children with autism is often overlooked in the designs of specialized schools. In recent years, schools and kindergartens focused on students with autism spectrum disorders have been estab-

lished more frequently, but most of these activities simply involve the adaptation of existing facilities or new buildings built based on the model of typical public facilities. As part of these projects, it is usually not the space that is comprehensively planned, but only the curriculum.

Based on the available guidelines and the analysis of the needs of people with autism spectrum disorders, an original classroom design for preschool children was developed (Fig. 4). A division into a quiet zone was proposed, where activities requiring concentration take place, and a play zone, which is also an adaptive zone after entering the classroom. The classroom is preceded by a transition zone that is a buffer between it and the noisier spaces. The zones inside the room have not been separated by permanent, vertical partitions, but their functions are legible, among others, thanks to the change of the floor – a soft undercoat was used in the play area, so that the change could be felt with the use of different senses. Additionally, the lighting



Fig. 5. Żory, Pawlikowskiego estate, special school design:
 a) ground floor plan,
 b) visualization of one of the inner courtyards (designed by Toprojekt studio, source: [31])

II. 5. Żory, Osiedle Pawlikowskiego, projekt szkoły specjalnej: a) rzut przyziemia, b) wizualizacja jednego z wewnętrznych dziedzińców (proj. Pracownia Toprojekt, źródło: [31])

is varied – in the play zone, the horizontal window introduces a large amount of natural light and provides a view of the natural landscape. In the education zone, the priority was to reduce distracting external factors, therefore upper lighting was planned. Both parts can constitute one space or be separated by movable acoustic partitions. The equipment of the classroom also allows for its flexible use – the student can at any time choose to work independently or in a group, as well as rest in the second part of the room or in a hideout on the covered terrace adjacent to the classrooms. The sensory garden located there provides the possibility of self-stimulation.

Emerging designs of specialized schools, which do not only address autistic children, are an optimistic forecast. An example of such a facility is a special school in the Pawlikowski estate in Żory. The facility, designed by the Toprojekt studio, complements the existing buildings on the plot – L. Krzemieniecka Kindergarten No. 23 and Spe-

cial School No. 22. The main assumptions were to provide specialized teaching spaces, a new gymnasium, and to improve the conditions for caring for children with mild and moderate intellectual disabilities (Fig. 5).

Due to the neurodiversity that occurs in children, the facility has been divided into three zones: for users with moderate mental disabilities, for students with mild disabilities, and a buffer between them composed of common areas. In the middle part there are rooms that require less concentration – a dining room or a gymnasium. The classrooms are separated by atriums, which provide lighting, constant contact with nature and improve acoustic comfort. *Green elements in the form of internal courtyards and external terraces, divide – as stated in the description of the design – classrooms, provide light to rooms and have a therapeutic function, creating sensory gardens, accessible directly from the rooms, separated individually for individual zones* [31]. It should be noted, however,

that the presented examples are exceptions – in Poland, there is no program of building kindergartens and schools adapted to the specific needs of children with autism spectrum disorders.

Conclusion

The design concepts presented in the study are based, among others, on the paradigms of universal design, which takes into account various needs and limitations of users, as well as how their functioning changes at subsequent stages of life. The Universal Design Code consists of seven principles. The first one concerns **equal access** – the facility is to be available to everyone by default, without the need to use additional solutions for individual groups. The **flexibility** of solutions should provide users with freedom in the use of space, and at the same time the **use of the building must be simple and intuitive**. This will be facilitated by **legible information** provided in various forms, which includes, among others, clear communication and markings. Another rule – **error tolerance** – reminds us that the designer should predict possible errors and minimize their negative effects. The facility planned according to the principles of universal design requires **little effort** by the user and provides **sufficient space** for comfortable use by a person of any size and varying degrees of mobility. Under the influence of the research, the set of guidelines presented was refined or transformed in the designs for children with autism spectrum disorders. This shows that universal design turned out to be insufficient. Attempting to satisfy the needs of all users generates many problematic situations, and the elements facilitating the use of one group may make other

groups uncomfortable. Moreover, such conflicts of interest also exist within a single group – the development of high-functioning students with autism spectrum disorders could be limited by isolation from neurotypical peers, and children with ASDs on the opposite end of the spectrum would not be able to develop effectively in an integrated school. Therefore, are we able to design universal schools, or will it remain just a utopian desire? We are still at the beginning of the road in terms of designing for autistic people, and the answer to this question may come along with the intensification of research and evaluation of the impact of architecture on autistic users.

It seems, however, that today there are several elements and activities worthy of being included in the universal design code in the concepts of school buildings for children with autism spectrum disorders. The most important activities include:

- space sequencing (creating simple room layouts in an order related to the building use schedule, as well as similar in terms of sensory control),
- design of buffer zones, sensory neutral between spaces with different functions and/or levels of sensory control,
- attention to acoustic conditions, the use of subdued colours and diffused light,
- designing “hideouts” – places to calm down.

The buildings of kindergartens and schools should not imitate the neurotypical “reality”, they should constitute safe and friendly space that responds to the needs of autistic people, supports their therapy and development through consciously applied design procedures.

*Translated by
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Abstract

Educational spaces for students with autism spectrum disorders

This study aims to present the relationship between the architectural surroundings and the needs of children with autism spectrum disorders in the educational environment. Therefore, it began with identifying the special needs of children with ASDs (Autism Spectrum Disorder) and the ways in which these needs are addressed in school designs carried out in the USA and Great Britain. The study also shows a few Polish attempts to create autism-friendly schools. Finally, an attempt was made to extend the paradigms of "universal design" with activities necessary to increase the comfort of using educational institutions by children with autism spectrum disorders.

Key words: education, school design, autism spectrum, inclusivity, universal design

Streszczenie

Przestrzenie edukacyjne dla uczniów w spektrum autyzmu

W niniejszym opracowaniu przedstawiono zależności między otoczeniem architektonicznym a potrzebami dzieci ze spektrum autyzmu w środowisku edukacyjnym. Rozpoczęto od wskazania specjalnych potrzeb dzieci z ASD (Autism Spectrum Disorder) i sposobów, w jaki odpowiada się na te potrzeby w projektach szkół zrealizowanych w USA i w Wielkiej Brytanii. W artykule pokazano też nieliczne polskie próby tworzenia szkół przyjaznych autystom, a na końcu podjęto próbę rozszerzenia paradygmatów „projektowania uniwersalnego” o działania konieczne do zwiększenia komfortu użytkowania placówek edukacyjnych przez dzieci ze spektrum autyzmu.

Słowa kluczowe: edukacja, projektowanie szkół, spektrum autyzmu, inkluzywność, projektowanie uniwersalne

