Classroom Design for Children with an Autism Spectrum

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Abstract. In modern societies, the group of people with dysfunctions related to the spectrum of autism is becoming increasingly numerous. A specialized approach to space design for this group of people is becoming a necessity. Particular attention should be paid to the rooms where children with autism spectrum disorders spend a lot of time - to classrooms. The arrangement of space can strongly influence their behavior. Special attention must be paid to the size and proportions of the room, the sense of order in space, proper sunshine, shading and ventilation, as well as to the reduction of detail, the excess of which leads to aggression and lack of concentration in this group of people. Another important element is the proper furnishing of the room, clearly informing about its purpose, or creation of clear zones. However, we are not always able (for procedural and financial reasons) to build complex daycare centers or schools for autistic people, and adaptations of existing rooms impose many limitations. However, despite this, at Tadeusz Kościuszko Primary School No. 11 with Integration Classes in Katowice, an original attempt was made to implement the above assumptions. It includes space zoning, floor differentiation, appropriate lighting, adequate equipment with the elements that are not typical for regular classrooms, as well as color markings and pictograms on the walls, which will be presented in more detail below. All this will undoubtedly lead to better comfort of use.

1. Introduction - Special Design
It is indisputable that we can influence human behavior by means of space arrangement. The proportions of the room, the colors, the materials used, the sunshine or artificial light, are the stimuli perceived by the body that influence the behavior of people in a constructed environment. Therefore, no one is surprised by the special approach to designing space for the education of children and young people. That subject is addressed by numerous manuals and standards based mainly on ergonomics. There is also a lot of literature on how to design “without barriers” for people with motor or sensory disabilities (visually impaired, blind, hearing impaired, deaf or deaf and mute persons). However, the process of designing usually does not take into account the barriers to the constructed environment for people with cognitive or mental disabilities. Therefore, designed rooms, including those intended for learning, are adapted, in terms of dimensions and colors, to the age and physical parameters of their users. It is worth noting that, most often, these are usually group workrooms, designed for groups of 15-30 people in the case of primary schools, and even up to 40 people for post-primary schools. Thus, some averaged values have to be taken into account in designing, so as to prioritize the group over the individual, in a way.
Designing for children with autism spectrum requires a much more individual approach and cannot be clearly defined or described by a norm. From the very beginning, the question should be asked of what autism spectrum actually is? It is widely believed that it consists in the development of a person different from regular. Autism is a complex developmental disorder affecting communication, social skills and imagination [1]. Its varieties may include differences in the way the person communicates, establishes interpersonal relationships, expresses their emotions and manages them. Children with autism spectrum may also demonstrate different methods of learning, and the pattern of their behavior in specific situations cannot be fully predicted. Each person with autism spectrum is an individual, and the individually variable characteristics indicated above can occur with a different degree of intensity.

Our times are characterized by a year-by-year increase in the number of children with diagnosed autism spectrum. It is estimated that about 1 in 100 children in the UK and 1 in 68 children in the USA are diagnosed with single or multiple autism spectrum disorders [2] (ASD). In Poland, it is estimated that there may be about 340,000 people with autism, 80% of whom are children [3]. Therefore, the rooms in which their education takes place should be adapted to their needs.

2. Design guidelines for space for people with autism spectrum

The growing population of Europe and, above all, children with autism spectrum disorders, makes the issues related to architectural design, and especially interior design, in which children with autism spectrum spend time, interesting for more and more architects. The best known design office is GA Architects, operating in the UK [4]. These architects deal with all the design aspects comprehensively, in a constructed environment so that it is friendly for people from the autism spectrum [5]. The general recommendations cover the issues within the following scope [6]:

- a sense of peace and order in space
- adequate level of sunshine and ventilation
- reduction of detail(s) so as not to introduce too much visual stimulation
- proper proportions
- proxemics (the suitable amount of space between people that they consider necessary)
- stopping of intruders (ensuring that people with autism spectrum are safe in their environment)
- materials that are durable and easy to maintain
- good observation
- good acoustics

However, in special designing, of which designing for children with autism spectrum is an example, attention is also drawn to other, more unquantifiable factors, which can be divided into the following groups: [7]

- imagination (limited ability of people with ASD to create a mental map of what is located e.g. on the other side of the door
- communication (adapting the environment by means of easy-to-understand codes with a small number of elements and permanent meanings)
- social interaction (due to specific proxemics, it is advisable to create larger spaces that encourage interaction and communication between people, but also offer the possibility for “withdrawal”)
- sensory difficulties (frequent hypersensitivity to visual, auditory or tactile stimuli, but rooms for sensory stimulation, called Snoezelen, are also recommended).
- behaviors and dangers (agression and auto-agression frequent in persons with autism spectrum)
All the guidelines presented above are, of course, also reflected in interior design. However, in this case, even more attention should be paid to the details and elements that affect children within the interiors. The space in which they learn must be friendly to them, must facilitate their concentration, stimulate them to act while strengthening their self-control and control over their emotions. This is much easier to achieve with newly designed education and care centers, where we can plan the space from the beginning, giving them the right proportions and combining them properly. The dimensions of the designed study rooms are very important. The surface of the classroom for children with autism spectrum is different from the traditional one. That difference results from smaller groups in which these children learn. It is assumed that the best results are achieved by working in groups of 4-6 people, but the classrooms should also have other spaces (for movement or silence), in addition to traditional desks with chairs.

However, it is not always possible to design a new building. Many Polish institutions are completely unsuitable for autistic children. In many Polish schools, autistic students learn in traditional classrooms. If a student learns in an open-access class, the number of students in class in grades 1-3 of primary school should be no more than 25. An integration class may also be set up in agreement with the school's governing body. The number of students in such a class in a public school is not more than 20 including no more than 5 children or pupils with disabilities, in an open-access school, in a class for students with autism, including Asperger's syndrome - no more than 4 students, in a special class organized for students with various disabilities, including autism - no more than 5.

This leads to some minor modifications within the existing classrooms in schools, but most often they are insufficient and are only of an ad hoc nature.

3. The most important problems of currently existing schoolrooms - classrooms
On 2 April 2019, as part of the events related to the World Autism Awareness Day, the project of adaptation of the classroom made for Tadeusz Kościuszko Primary School No. 11 with Integration Classes in Katowice was presented (Figure 1). The classes for children with autism spectrum disorders are conducted there in integration classes, in a large, rectangular classroom for a group of 24, including children with autism spectrum disorders. The existing room did not meet the needs of children with autism spectrum in many respects.

The most important and urgent elements that required the most urgent intervention were:
- absence of zoning of space within the room, contributing to increased anxiety when changing activities within the room,
- no possibility of orientation in the room - lack of visual identification marking out the zones and pointing at them - one should remember that it concerns both the floor and the walls,
- inappropriate colors - although the walls and floor of the room were in subdued colors, the equipment and mobile elements were of random, aggressive colors which were undoubtedly annoying,
- inadequate and uneven lighting - no adjustment, no zoning, no change of color or intensity,
- inadequately shaped hygienic zone - a single washbasin at the wrong height,
general chaos caused by the lack of appropriate equipment and accumulation of simultaneously exhibited scientific aids used for various purposes.

Figure 1. Condition of the existing classroom - projection

All these elements and, in particular their accumulation, caused the room to make it difficult for children with autism spectrum disorders to acquire new skills rather than support the learning process. The complete lack of space for storing the respective things used for education, especially arts, and personal trinkets, which very often facilitate adaptation and help in stressful situations, also proved to be an urgent problem.

Other issues related to the accompanying space also emerged. The most important one was the absence of a toilet for this classroom, which made it necessary to walk using an open-access corridor. The lack of space connecting the classroom for autistic children with the school corridor and the lack of clear marking of that corridor was also causing concern for users. The doors leading away from the known and “safe” space were not marked in any way, which resulted in cases of uncontrolled and unwanted exiting into the area of the open-access school corridor which was crowded and noisy, especially during breaks.

4. Changes introduced

The scope of the changes introduced to in the room was limited for several basic reasons:
- no possibility to reduce the size of the group using the room
- no separate entrance possible - for safety reasons
- the need to maintain the existing central heating installation
- the need to preserve the existing wall openings (windows and doors)
However, despite these limitations, the room has been adapted to the maximum possible extent. The unused vestibule room at the external exit was used for storing equipment and teaching aids (so that the ones that were not being used at the given time do bring chaos into the space). The vestibule leading from the corridor to the classroom was used as a transitional adaptation space, and the unused room on the north side of the corridor was adapted for toilets dedicated to this group of pupils only. In addition to the aspects associated with reconstruction, many changes were introduced to the interior of the classroom itself. These include: space zoning (Figure 2), floor surface differentiation, introduction of visual identification resulting from space zoning, appropriate furnishings, lighting.

![Figure 2. space zoning introduced](image)

4.1 Space zoning
Three zones outside of the main room were added:
- storage zone,
- welcome zone,
- toilet zone.

The space zoning itself in a large room consists mainly in using real (introduced wall lower than the main walls of the room) or visual (change of flooring, material, colors) markers for the respective zones. In this case, there is a separate hygiene and sanitary zone, equipped with two under-counter washbasins (to increase the comfort of use thanks to the possibility of being placed on the worktop and to make it easier to keep the washbasins and floors clean), appropriately marked in color. Quiet zone - a work zone divided into group work (with six-person tables) and individual work (one pupil per teacher), with a place for quiet communication, which can also be used for motor exercises or positioning objects in long lines, and a play zone which also serves as an adaptation space immediately after entering the classroom.
4.2 User-friendly elements - flooring

Many improvements were also introduced on the floor (figure 3, 4). Its texture, color and hardness changed. In the sanitary zone (at the washbasins), as well as in the corridor along the room, an anti-slip, corrugated, dark grey flooring was placed. In addition, areas in front of the washbasins were designated to mark the areas for cleaning. Similar flooring was introduced in the zone in front of the room. The work zone is made of weldable flooring in light grey. By means of a light green strip, a clear optical boundary for these zones was created, although they are not separated by vertical partitions. The play area, which is also the adaptation zone of the room, is carpeted in the form of colorful jigsaw puzzles. A soft underlay was introduced under the carpet, which gives the possibility to physically feel the borders between the two zones.

![Figure 3. user-friendly elements – floor](image)

![Figure 4. user-friendly elements - walls and ceilings](image)

4.3 User-friendly elements - walls and ceilings

The walls and ceilings of the room were also designed to facilitate the use of the room. The ceiling in the sanitary section was lowered to improve the proportions of the recess. In order to improve comfort and introduce a variety of textures and colors on the walls, a wall made of cork, lower than the main walls of the room, was introduced, which will further improve the acoustic properties of interiors. The remaining walls are cream-colored, with the exception of the wall closing the play area, which has remained white as it also serves as a screen for the projector placed on the ceiling. However, the most important element introduced to the walls are light blue ribbons - leading to the sanitary zone in the room and dark blue ribbons - leading in the opposite direction to the door preceding the entrance zone and the toilet. On those strips, there are also arrows indicating the direction and pictograms which simply inform which zone they are heading to. In addition, the doors leading to the school corridor were painted red and marked with a pictogram - a visual warning signal to indicate leaving the “safe” zone (Figure 5).
Figure 5. Elements on the wall

4.4 User-friendly elements - interior fittings
All the elements and furnishings of the interiors were designed to be safe and to facilitate orientation in the room. The windows are covered with Roman blinds in a neutral color, the tables are also neutral (grey) and with rounded corners, with places in the central area where school utensils can be placed so that they do not take up space on the table and fall to the floor. The colorful variety of chairs is supposed to make it easier for every child to find his or her place. The drawers where children will store their personal belongings or individual teaching aids have the same colors as the chairs (Figure 6, 7).

In addition, in the play area, a podium with steps has many functions. It can be used as a place for sitting but, above all, thanks to the drawers in the lower part, it is also possible to hide unused teaching aids in them, in order to eliminate the impression of overfilling the interiors. The podium also serves as a seat for presentations made by children on the carpet, and the illumination introduced in it allows various interior arrangements.

However, the most important element of the interior design is the felt houses. They serve as places of silence and isolation from external stimuli, which is extremely important for children with autism spectrum, who find it difficult, or even impossible, to concentrate because of excessive external stimuli.

A bamboo panel was also introduced in the interiors, which produces sounds when touched with a baton. The remaining furniture is in neutral colors (white and grey) and serves mainly to hide all the items not being used at the given time. Inside, there is also a corrugated mobile panel with sound-absorbing properties and can be used for individual work with a teacher.
4.5 User-friendly features – lighting

A very important element to pay attention to when designing space for people with autism spectrum is an appropriate interior lighting (Figure 8). Not only its quantity is important, but also its intensity, color and the ability to control it. In the room, upper lighting with the possibility of adjusting its intensity and additional lighting in the form of a led strip built into the seats in the play area were introduced. Also, a led bar was introduced under the ceiling along the entire length of the room. This allows introducing dimmed lighting, e.g. for a multimedia presentation from the projector. In addition, concentrated lighting was introduced in the washbasin area, above each individual basin. To make it easier for children to orient themselves in space and, at the same time, give them a clear signal when to stay in the room and when to leave it, colorful lighting was introduced above the entrance door. The green color means you have to prepare to leave the room.
5. Conclusions
Undoubtedly, smaller rooms for groups of 4-6 people are much better space for working with people with autism spectrum [7]. However, the realities of Polish schools do not always allow conducting classes in such rooms. Therefore, what can be done are an adaptation of the existing rooms and the introduction of elements that will make them as user-friendly as possible.

All the changes introduced in the designed room are aimed at adapting the space of the existing room to the specific needs of the pupils with autism spectrum learning in them.

The most important ones include appropriate zoning of space, which allows alleviating slightly the discomfort caused by working in a group with too many participants. In addition, the comfort of use will also be increased by the diversity of the floor, both in terms of texture, color and material, which will allow children to orient themselves organoleptically (by means of touch), as well as the appropriate colors of walls and equipment. Undoubtedly, the placement of small houses in the room that will allow the users cutting themselves off from the stimuli will also be beneficial. In turn, the furniture allowing hiding all the unused items will allow avoiding excessive visual stimulation (Figure 9), which is currently very common in classrooms, where all the scientific aids, including those not being currently used, are visible. Clear pictograms and associative coloring of elements, as well as graphical markings on the walls and appropriate, controllable lighting, will certainly improve the comfort of the study and the results obtained by students.

This, in turn, will contribute to better performance of the children and allow social interactions and give the opportunity to calm down and “withdraw”. All these elements will surely also lead to a sense of safety and to the elimination of aggression and auto-aggression, which is undoubtedly the most important issue during classes with groups of children with autism spectrum.

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