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Hanna HREHOROWICZ-GABER[1]
Rafał BLAZY[2]
Alicja HREHOROWICZ-NOWAK[3]
Jakub BŁACHUT[4]
Mariusz ŁYSIEŃ[5]
Agnieszka CIEPIELA[6]
Jakub DUDEK[7]
Felicjan LEWANDOWSKI[8]
Wiktor HŁADKI[9]

THE NEW EDUCATION SPACE THROUGH THE EYES OF USERS AND DESIGNERS

The space in which young people learn undoubtedly has an impact on the quality and effectiveness of learning. Following this lead, the project team, supported by participatory activities, created the concept of a modular mobile classroom that responds to contemporary environmental and social challenges.

Keywords: educational facilities, participation, spatial planning, child welfare, building materials, ecology

[1] Hanna Hrehorowicz-Gaber, Cracow University of Technology; Faculty of Architecture, Warszawska 24, 31-155 Cracow, Poland; hanna.hrehorowicz-gaber@pk.edu.pl; orcid.org/0000-0002-1567-6172

[2] Rafał Blazy, Cracow University of Technology; Faculty of Architecture; orcid.org/0000-0002-0466-8855

[3] Alicja Hrehorowicz-Nowak; Cracow University of Technology; Faculty of Architecture; orcid.org/0000-0002-4664-9740

[4] Jakub Błachut; Cracow University of Technology; Faculty of Architecture; orcid.org/0000-0002-8523-1910

[5] Mariusz Łysień; Cracow University of Technology; Faculty of Architecture; orcid.org/0000-0002-7500-4036

[6] Agnieszka Ciepiela; Cracow University of Technology; Faculty of Architecture; orcid.org/0000-0002-3280-4674

[7] Corresponding author: Jakub Dudek; Cracow University of Technology; Faculty of Architecture; Warszawska 24, 31-155 Cracow, Poland; jakub.dudek@pk.edu.pl; orcid.org/0000-0002-1541-9512

[8] Felicjan Lewandowski; felicjan99@gmail.com

[9] Wiktor Hładki; Cracow University of Technology; Faculty of Architecture; (II degree student)

1. Introduction

The educational space plays a key role in the learning process and development of students, as their time spent in school is significant, for the quality of education. It is an area that has a direct impact on the effectiveness and effectiveness of teaching. In addition to teacher relations and student engagement, the organisation and spatial layout both inside and outside schools play a key role in the learning process. A well-designed learning space can stimulate student interest and motivation, support a variety of learning and social interactions, and facilitate creativity and the development of interpersonal skills. In addition, the school's outdoor environment, such as sports fields or school gardens, are important places for physical activity, recreation and the formation of social relationships.

As far as completed and functioning facilities in Poland are concerned, in many cases we are building on the legacy of the socialist period, where school buildings were constructed, later called '1000-year-olds', in response to the then ongoing process of combating illiteracy, which is still present today. These buildings, while initially responding to the urgent need for places of learning in the post-war period, now face the challenges of outdated architectural design and inadequate facilities to meet new educational needs. Characteristic features of the '1000-year-olds' often include a monotonous, cuboidal layout, relatively large school spaces and limited spatial flexibility - which is not always conducive to a variety of teaching methodologies and diverse learning styles. These buildings also rarely took aesthetic and ergonomic aspects into account, which affects the comfort of students and teachers.

The second significant group are pre-war schools, built before the era of architectural standards, are usually characterised by significant constraints that have become apparent in their structure today. Many of these buildings have corridors with narrow spaces, limiting the freedom of movement of students and teachers between classrooms. Small, small windows, on the one hand, limit the amount of natural light entering the interior, while on the other hand, they hamper ventilation and contribute to poor user comfort. Limited classroom space and non-functional classroom layouts are often not conducive to modern teaching methods. In many cases, ergonomic aspects are practically neglected, compromising the comfort of students and teachers. Both in the case of the so-called 1000-year-old buildings and in the case of pre-war buildings, energy efficiency is a major problem, as most of these buildings are poorly insulated and equipped with outdated heating systems.

As part of the research project 'School of the future: a modular and mobile green classroom system and Mobile Green Classroom System', an interdisciplinary group of researchers was involved in exploring the possibilities of improving the functionality of educational facilities by introducing an extension based on a designed system of modular and mobile green classrooms. The idea was to revolutionise educational spaces by creating flexible, functional and energy-

efficient learning environments. The concept of modular and mobile green and mobile green classrooms aimed to provide modern classroom spaces that can be flexibly adapted to educational needs. The system of these classrooms was based on modules that were easy to assemble and dismantle, which allowed the creation of a variety of learning spaces depending on specific requirements. Their mobility allowed for flexible use of outdoor and indoor spaces, integrating learning with the natural environment. The additional space of the 'Green Classroom' could be a classroom or ancillary space (library, study, or rest area during breaks), realised in a modular system, adaptable to the existing site conditions.

Greenery was a key aspect of these modular classrooms, integrating natural elements into the educational environment. Through the use of vegetation and modern irrigation systems, a healthier and more stimulating learning environment was provided for students and teachers. The system also sought to improve energy efficiency and stimulate students' creativity and analytical skills through modern architectural and ergonomic solutions.

The modular system makes it possible to create completely new school establishments or expand existing ones. In order to meet the real needs of users, Kraków schools were invited to the project in order to coordinate the most important needs of pupils and teachers and to support the creation of space according to real needs and teachers and to support the creation of spaces to meet real needs.

2. Research - survey and public participation

„The school community needs to be a participant in the design of the learning space. The participation of pupils and teachers can concern not only large investments (building or rebuilding a school), but also parts of the school space. We can easily imagine different situations in the life of a school. When the involvement of the school community in the design could bring significant benefits going beyond 'building and renovation issues" [1]. Therefore, the first stage of the project became a diagnosis of the needs of educational facilities - primary and secondary schools. This was accompanied by survey workshops and working meetings, which helped the team to outline the main needs and priorities for educational spaces. Interviews were used as an introduction to the concept, verified by the development of good practices, which made it possible to develop a scheme for seeking solutions.

The areas of diagnosis were divided by the specialists into: measurable, which the in-situ team investigated, and non-measurable, which the results of the student and teacher surveys were more descriptive about. Participation of future users was a priority for the project, so the national survey was complemented by project workshops and participatory observation at least at the local scale.

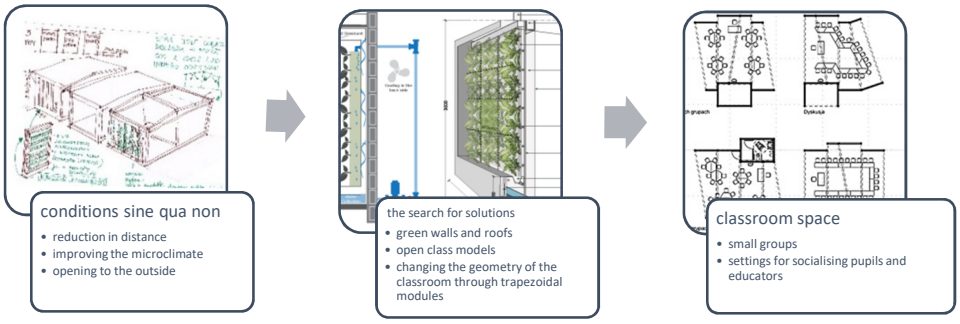

Fig. 1. Components of creating a green classroom vision

Historically and methodologically, the process of changing approaches to sustainable action, with a direct impact on transformations in the education system, was initiated at the session of the United Nations General Assembly, 26 May 1969, by the UN Secretary-General, Sithu U Thant, author of the report Man and his Environment, expressed in resolution 2390 [2, 3]. The basis for including children and young people in the spatial planning process as equal partners and users of space was established by the Convention on the Rights of the Child, adopted by the UN General Assembly on 20 November 1989.

The optimal size of the school is an important consideration, as a school that is too small can be economically inefficient, while one that is too large can generate stress and crowding due to the number of people in one place. The height and number of storeys of a building also matter - single or two-storey facilities often prove more functional than multi-storey ones [4]. Small schools are recommended because of the conducive social interactions - students can establish a more relaxed relationship with teachers and school staff, which leads to active participation in the life of the establishment. Research has shown that the larger the school, the less pupils participate in the life of the establishment; in smaller schools the chances of pupil involvement are greater [5].

Nowadays, the learning process is often seen as gradual - involving the division of teaching work into separate age groups to be served by divided spaces in the school structure. Work space is provided in relation to the age groups. Shared space is only marginally desirable due to the potential dangers of the youngest users interacting with their older colleagues. Only the internal communication in the facilities is this common space, often further restricted to some extent for similar age groups within stays on the same floor. A kind of melting pot is the school canteens and common rooms - places that allow extra-curricular contact with students of different ages. However, as pupils grow older and become more independent, fewer pupils attend, leaving this space for younger pupils.

Fig. 2. Relatively not too large and narrow corridor spaces. (Source:https://commons.wikimedia.org/wiki/File:Bytom_Bobrek_Rataja_3_interior.jpg autor Adrian Tync)

The optimised educational space is intended to influence concentration and the ability to remember (the architectural forms permeating the environment are intended to influence this) and the shaping of pro-environmental attitudes in the audience (biophilic interior).

The final choice of wood as the material for the modular system was influenced not only by aesthetic considerations, but also by thermal insulation. Material availability, carbon footprint and recycling, better ventilation and air quality [6,7]. Wood allows a certain flexibility and modifiability of solutions [8].

However, its greatest asset was the fact that both children and adults (parents and educators) pointed to it as the most desirable building material. Its presence in interior design brings an element of cosiness, warmth and naturalness, which contributes to a more comfortable environment. Psychologically, wood has a calming and relaxing effect. With its natural texture and warm tones, it makes an interior more welcoming and conducive to relaxation. The material has the ability to harmonise spaces, which can help to reduce stress and improve the overall quality of being there. Wood also has the ability to influence the senses - its natural scent and texture can evoke positive emotions and increase a sense of closeness to nature. This can be especially important in urban environments, where contact with nature can sometimes be limited.

In addition, wood, as a decorative element of an interior, can influence the perception of the quality of the materials and finishes in a room, which can in turn affect the self-esteem and confidence of the occupants of such a space. Interiors with a predominance of wood can also be more eco-friendly, which is important for those who value conscious living and closeness to nature. Finally, the interdisciplinary team of specialists involved in the project identified wood as the most suitable construction and finishing material for modular and mobile green classrooms.

The ultimate aim of the project was to create a design for an educational space, characterised by a modular design and innovative technological solutions that will ensure the expansion of educational opportunities in educational units in the event of problems with premises or various types of threats such as Covid 19 or the migration crisis.

3. Modular construction

Modular construction refers to buildings constructed from prefabricated, modular parts. Thanks to standardisation and the wide range of modules and segments, many buildings with different functions and designs can be built using standardised components. with different functions and design using standardised components. This way of constructing buildings offers many possibilities for adapting the building to the needs of users and the environment [9,10,11]. Hence the choice of modular construction for the 'School of the Future' project. Thanks to developments in modular construction technology, it is possible to build permanent houses, public buildings or many other functions. Many times nowadays, these are no longer temporary barracks or containers, but fully functional houses or office spaces that are used year-round. There are a number of hotels, schools and kindergartens around the world that have been built using the modular construction method, such as the Citizen Hotels hotels in Amsterdam and Paris, the Puukuokka One in Finland, the Koota residential building in Porvoo, also in Finland in Finland [12].

3.1. Advantages of modular construction and its application for educational buildings

In addition to a range of adaptability, one of the main advantages of modular construction is the speed of construction of the building [13]. The construction time for buildings using modular construction techniques can be up to twice as short as for traditional construction techniques. This is an extremely important issue from the perspective of quickly providing places for children in educational establishments. The prefabricated modules are manufactured in enclosed halls where weather conditions are irrelevant. From the fully-automated production line, 90% of the modules are ready

to roll [14]. When building with modules, there is no need for a traditional fully equipped building site, and the terrain and ground requirements are not as high as for heavy traditional construction. and ground requirements are not as high as in the case of heavy traditional construction [15,16]. The advantages of this construction technique are ideally suited to the needs of education buildings, primary schools, secondary schools or kindergartens.

Thanks to the flexibility in the choice of components, it is easy to adapt any design to the needs of the student community. The size of the building or rooms can be simply and easily reduced or increased, and the layout can be changed at will [17]. Such design becomes easy, as issues of technological requirements in the field of structural engineering are preserved during the production of standardised modules. The aforementioned participation of primary school pupils was made all the easier by the fact that pupils were even able to easily propose the layout and shape of their school building themselves, which would suit their needs.

Fig. 3. Design of a prefabricated kindergarten
(Source: https://climatic.pl/szkoly-i-przedszkola-modulowe/)

3.2. Disadvantages of modular construction and its limitations

However, modular construction technology is not without some disadvantages, which, to be fair, cannot be overlooked. One disadvantage is related to the financial issue. The price of individual modules is relatively high. It is quite expensive to produce modern modules of a certain standard and quality. However, the price of a building in traditional construction consists of many other components which do not burden the cost estimate of modular technology. When comparing buildings of a similar standard, modular construction often results in a lower final cost. For example, building an all-year-round two-storey house with an area of 100 m^2 in finished standard costs between PLN 450,000 and PLN 700,000 (according to average prices in Poland for the year 2023). The same area in a modular system of a single-storey house can be built for the amount of PLN 350,000–550,000 (depending on the standard of finishing).

Due to the different construction technique, there are also other complications. Heavy equipment is required to erect a modular building. A heavy-duty crane is required; one 35 m^2 module can weigh between 11 and 14 tonnes. Suitable conditions must be provided for the access and positioning of such a crane. In addition to this, delivering the modules to the construction site can also prove problematic, where the weight of the modules is also an issue, as a trailer with a sufficient load-bearing capacity must be provided. Another disadvantage is the structural limitations. The modules are usually cuboids topped by flat roofs. Constructed this way, there are fewer options for composing them together. Therefore, modular buildings are generally similar to each other. Such restrictions on the architecture of the building and the imposition of a specific minimalist style may not suit all users. Flat roofs are also not permitted in all Local Development Plans.

Fig. 4. Example of a modular recreational building. (Source:https://isanok.pl/pl/661_materialy-partnera/28874_czy-domy-modulowe-sa-uniwersalne.html)

4. Examples and good practices of modular construction for educational buildings

The need to build new educational investments is variable in proportion to the current demographic structure of the country. There is also a noticeable lack of adequate educational infrastructure especially in smaller municipalities, and meeting expectations and needs often depends on the budget of the administrative unit, which is often not sufficiently funded. An example of rapid response to community needs can be seen in a kindergarten in the Czech city of Prague. The existing old building no longer met the standards for children's accommodation and had to be demolished. It was necessary to act quickly because the users were left without help and kindergarten. It was therefore decided to build a modular building with an area of 982 m^2. The whole project took four months to complete.

Fig. 5. Kindergarten in Prague (Source: AGE project)

Other examples of the realisation of public buildings this time on Polish soil are:

Modular school in Stężyca. 1,500 m^2, equipped with 10 teaching rooms, and 5 specialist laboratories. This ecological investment was completed in 12 months. In 2022, the building was awarded in the national competition of the Ministry of Climate and Environment for the ‘Best completed green building project in 2022’.

Fig. 6. Modular school in Stężyca. (Source: https://ecologiq.pl/)

Modular school in Łomianki. A 2,800 m^2, two-storey education building designed to house and accommodate 240 children at a time. This building, made of prefabricated wooden elements, was erected in 2021.

Fig. 7. Modular school in Łomianki (Source: https://ecologiaq.pl/)

Jabłoniowa Education Centre. The state-of-the-art modular school and kindergarten is the largest prefabricated timber frame technology-built educational complex in Central and Eastern Europe. It covers an area of nearly 10,000 m^2, the first part of which is a primary school capable of accommodating 800 pupils, while the second segment of the complex is a kindergarten designed for 200 children. The construction of the energy-efficient complex took 1.5 years from the breaking of the first shovel to the completion of the complex, which would not have been possible with a traditional construction method for such a large investment. The construction of the building is based on box-type ceilings, a technique which is characterised by its fire resistance, as in the event of fire the elements retain their load-bearing capacity, airtightness and fire insulation for up to 60 minutes.

Fig. 8. Jabłoniowa Education Centre (Source: https://ecologiq.pl/)

5. Conclusion

It is not easy to meet the challenges and educational needs of students in a modern and developing school. Designers need to draw on modern, ecological and effective practices in creating learning and development-friendly places for the younger generation. In the creation process, it is important to refer to social research, good practice, and to participate with the stakeholders themselves. The aim of the project is to create a pupil-friendly educational facility. The selected wooden materials have a positive effect on concentration and the ability to remember. They build environmental awareness in pupils and have aesthetic qualities. With changing demographic factors, epidemic threats and migration problems, the high mobility of modular construction seems to be irreplaceable. Prefabricated modules, with the ability to compose them freely,

are ideal for the construction of schools, as they can be built using the ideas of the pupils themselves, which are explored in workshops. The multitude of already existing educational complexes built using the modular method in Poland and Europe proves how effective it is in creating a modern educational space that simultaneously meets social and environmental requirements.

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