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Methods for assessing the quality of architectural spaces of educational institutions

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Abstract. School plays a key role in the development of a person's personality throughout their life. The educational atmosphere largely shapes behavior patterns, especially for children and adolescents. The foundations laid at an early age often become decisive for the further development of the personality. Today, approaches to the educational process have undergone significant changes. The article presents a methodology developed by the authors that allows assessing the quality of architectural spaces of educational institutions by four main parameters. This will allow obtaining an objective picture of the state of educational spaces and making adequate architectural and design decisions at the administrative level. This work is based on an integrated approach to assessing architectural space, developing universal assessment models that allow correlating different-quality characteristics of school subsystems into a single assessment system, which will allow obtaining a quantitative assessment of the state of spatial indicators of educational institutions. Methods for assessing architectural spaces of educational institutions suggest entering a new stage of designing specific schools, eliminating serious consequences of architectural and design errors with large budget losses when implementing poor-quality development scenarios. The priority task of reforming the system of public authority is to create a qualitatively new level of public administration efficiency, including in matters of spatial development of educational institutions and renovation of existing schools. Because of the study, the main criteria and indicators of the quality of the architectural educational space were developed. The matrix of criteria includes such evaluation blocks as safe environmental design; formation of space; inclusiveness; stages of the physical condition of the building. The evaluation criteria were tested and refined in schools of the Republic of Bashkortostan. The results of the project implementation are methodological tools for assessing the quality of architectural spaces of educational institutions, an application for assessing the initial level of quality of architectural space, modeling the architectural planning solution of an educational institution and estimate documentation at the stage of an application for major repairs.

Keywords: quality of architectural educational spaces, quality assessment criteria, educational environment, methodology for assessing the quality of educational space

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1. INTRODUCTION

Today, the paradigm of educational processes has changed significantly. In earlier paradigm, the processes of education focused on the flow method of preparing students with a unified program. Now other qualities are required from students: the ability to receive and process information, work in a team and socialize, make free choices and make independent decisions. All of them require a completely different quality of space for these educational processes [1].

Analysis of existing methods for assessing the quality of the educational environment does not fully reflect the complex of architectural factors and parameters. This analysis focuses on assessing the quality of the school as a whole, using generalized data, including evaluative judgments [2]. This article considers the formation of a methodology for assessing the initial level of quality of architectural spaces.

Objectives:

- to define the main criteria for assessing the quality of the architectural educational environment based on the systematization and generalization of domestic and foreign experience in designing architectural objects on the topic of the study;
- to show the criteria for assessing quality using the example of individual educational institutions;
- to formulate options for the technical specifications for designing the architectural space of an educational institution;
- to develop at least three options for typical architectural planning solutions using examples of schools in the Republic of Bashkortostan.

Existing studies conducted in this area reflect the goals aimed at obtaining information about the current emotional state of the educational environment for further repair of a particular school [3]. In addition, many studies consider only one aspect, for example, psychological influence or assessment of various social aspects.

Currently, the state is looking for opportunities to renovate existing schools, and is currently launching programs to change them. However, children, parents and teachers, as the main customers of major school repairs, are no longer satisfied with simple solutions – they need to look for modern approaches. The problem is the need to determine the principles of modern solutions and specialists with the help of which these programs can be implemented. The Republic of Bashkortostan is one of the leaders of the Russian Federation and is a pilot region in the implementation of the state program «Dream School». To date, major repairs have been carried out at two schools in the Republic of Bashkortostan under this program.

2. MATERIALS AND METHODS

Based on existing practices in the study of architectural spaces of comprehensive schools, the principles of designing the educational environment have been identified and summarized [4, 5]. These are the principles of safe environmental design, space formation, inclusiveness and participatory design (Fig. 1).

Principles of safe environmental design. This principle involves creating an environment that promotes the absence or reduction of fear for a child, uncertainty in anything. Safety and comfort of stay are fundamental criteria for creating an architectural environment as a whole, and, of course, first, this concerns educational spaces for children. In particular, it is necessary to take into account the fact that when moving from kindergarten to primary school, children experience a certain stress [5].

For this purpose, a separate elementary school link is organized in the projects of modern schools, which, on the one hand, has a safe and intimate location in the general planning structure, on the other

hand, allows primary school students to gradually join the life of the school as a whole. In foreign school buildings, the hall layout has become widespread – the building is a common space for play and learning activities, and this space includes small rooms intended for classes that require isolation. Such a layout, according to many researchers, allows for openness and the formation of a certain freedom of thought in students [6].

The presence of open spaces in general education institutions reduces the spread of bullying among schoolchildren and encourages interaction and socialization. The possibilities of transforming the common space by introducing mobile partitions, furniture or mobile equipment will make this space functionally flexible to possible changes in the future [7]. The school space should become an open system with a designed possibility of transformation, in accordance with the needs of new generations of students [8]. Another factor in the safety of stay is the availability of recreation areas that provide comfortable social communication and participation in public events of the school, which form in students a sense of belonging to a single community engaged in a common cause.

Principles of space formation. Multifunctionality in school design means giving the educational space additional functional capabilities that expand the ability to use and apply this space [9]. These include: ease of movement, with a minimum of time, physical and emotional costs; comfort (conditions for receiving hot meals, rest, sports, the opportunity to receive timely and qualified medical care); mandatory and high-quality mastery of educational programs at all levels and additional programs, including special multi-level programs for gifted children; the opportunity to acquire certain work skills, to build a successful social career in the future; sustainable development and, at the same time, flexibility, transformability and mobility of the formed educational environment (readiness to transition to a new quality in accordance with changing current demands.

Based on the analysis of the strategy for sustainable development of the territories of the Russian Federation aimed at overcoming the global socio-economic crisis for the period up to 2030 from the standpoint of creating an educational environment, the following trends can be traced: the formation of the physical space of the school as a place for the implementation of creative ideas, scientific research, individual learning trajectories while maintaining the general structure of the educational process, participatory construction of the educational process - the involvement of all its participants in making joint decisions, active interaction between the teacher and the student; environmental friendliness of design and health conservation, resource conservation of space. Thus, the modern architectural space of a general education institution should become a kind of cradle of cultural, scientific and technical creativity and communication within the community created in schools.

Initially, the school was conceived as a progressive tool with the help of which the student receives certain universal ideas about the structure of the world. Accordingly, the physical space of the school surrounding the child, formed by the architect, should teach him to socialize, interacting with other people, reveal his individuality and help find his future calling [10-12]. The organization of the architectural space should provide children with the opportunity to spend 10-12 hours a day there, concentrating everything necessary in one building. Creating a memorable architectural image of the school, instilling trust and respect for the educational environment, is one of the primary tasks.

Principles of inclusivity. Inclusivity in the educational space provides an environment equally accessible to all, including categories of students with special needs and disabilities. It is a fundamentally new school architecture that can change typical ideas about education and form a flexible learning system, combining «smart» solutions, technology and accessibility. The strategies of cities of the future repeatedly mention the thesis about the environmental friendliness of the created «space of the future», in which a space of communication, equality for all and cultural ties is created [11, 13, 14].

Each function of the space, be it libraries, public spaces, cafes or sports grounds, should have the function of «socialization» and identity, which people experience through a sense of belonging to a place. «Smart solutions» should also work in the interests of people – efficient use of resources through the introduction of technological systems, achieving a better quality of life through improved services and information accessibility, the introduction of inclusive and environmentally friendly design in architectural spaces [15].

Also, such trends as biophilic design, based on natural closeness to nature, and non-extractive architecture, a new type of architecture that does not deplete the Earth's resources, construction based

on how not to create external negative effects for third parties, are actively being introduced into modern design of architectural spaces [16-18]. Such effects include not only problems with carbon emissions and energy consumption, but also the sustainability of ecosystems, the preservation of communities and the prevention of labor exploitation.

An inseparable union with the natural environment – the penetration of nature into buildings, is one of the leading modern trends in architecture. This penetration concerns not only the external effect of «fitting» the volume into nature, but also the «opening» of the interior and the entire building complex from the inside to nature and the inclusion of natural elements in the interior [19-21]. The study used such research approaches as systemic, structural and holistic. Also, the methods of architectural and retrospective analysis were used, which were used in the process of studying the experience gained, analyzed studies on the topic of educational spaces, interdisciplinary synthesis and the method of generalization [22, 23]. The modeling method was used to create a visual matrix and possible options for its use.

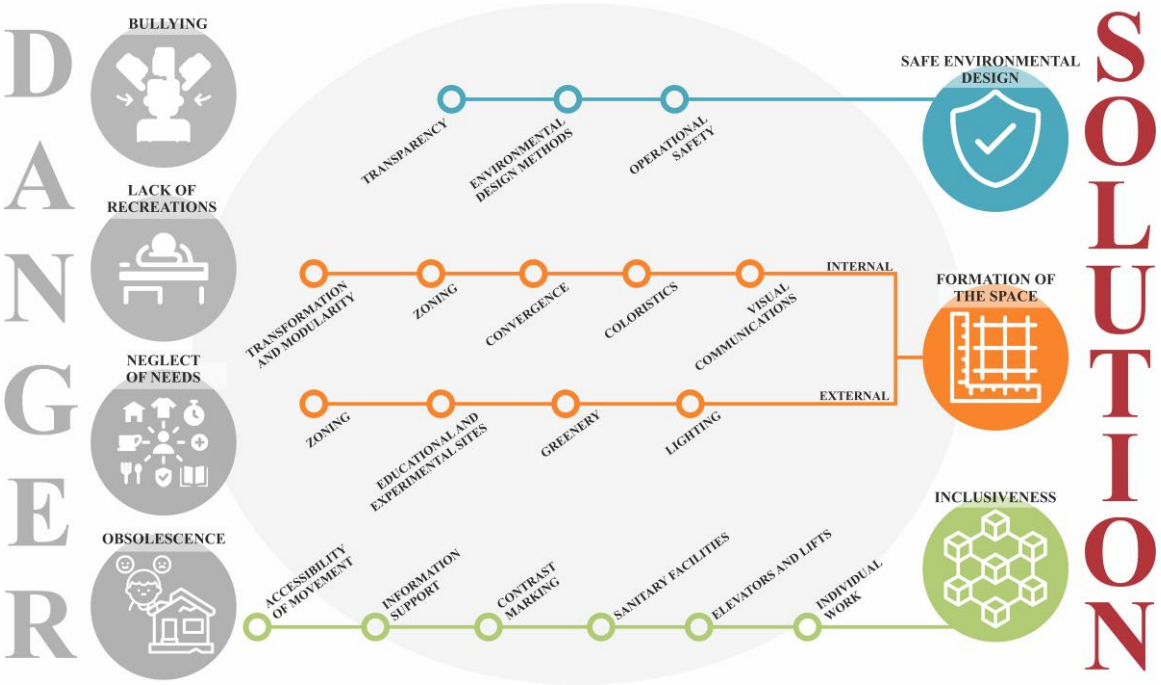

Fig. 1. Principles of space formation.

The methodology developed by the authors is aimed at developing a technical task for design based on a scale for assessing the spatial characteristics of educational institutions. This will allow obtaining an objective picture of the state of the architectural educational space and making decisions on the design of the school at the level of the administration of institutions [25]. This work is based on an integrated approach to assessing the architectural educational space, developing universal assessment models that allow us to correlate the different qualitative characteristics of the school subsystems into a single assessment system, which will allow us to obtain a quantitative assessment of the state of the city's spatial indicators.

The matrix of criteria and components of the educational space includes four evaluation blocks: safe environmental design; space formation; inclusiveness; stages of physical condition. Each block has several indicators; all indicators are assessed in points. In addition, all indicators have different weights depending on the given conditions. For example, the block «Safe environmental design» has three indicators, «Formation of space» consists of only eight indicators collected in two groups and «Inclusiveness» consists of six indicators, «Stages of Physical Condition» of five. The points for all indicators are based on evaluation methods or formulas, so some are assessed only by presence, some by condition. The sum of all points determines the state of the territory under study.

The next stage is processing the results obtained. At this stage, the result of the work performed is graphically presented. A comprehensive assessment of the architectural educational space is carried out according to four evaluation categories and is presented in graphic form. The result is a quantitative assessment of the state of the architectural environment of schools based on the sum of points scored in the four categories presented. The total sum of points of all categories shows in a quantitative format the degree of well-being of the school environment. Based on the results of the comprehensive assessment, a SWOT analysis of the studied urban space is carried out. The result is a consolidated analysis of all educational institutions and a comprehensive analysis of the well-being of the studied space of the architectural environment.

3. RESULTS AND DISCUSSION

The research was conducted in schools of the Republic of Bashkortostan. During the research, it was necessary to analyze educational spaces according to such parameters as safe environmental design, formation of internal space, formation of school territory, inclusiveness and physical condition of the building. The obtained information was systematized and assessed using a point system. The ranking criteria were preliminarily defined. The work considered seven schools: Republican Engineering Boarding School of Ufa (REBS), school in the village of Yazykovo, school No. 1 in Yanaul, school No. 2 in Agidel, Lyceum No. 2 in Dyurtyuli, Lyceum No. 9 in Sibay, Gymnasium No. 1 in Salavat and School No. 17 in Sterlitamak. This information was graphically displayed in the form of line graphs indicating the above indicators. Examples of the average assessment are demonstrated in Fig. 2-7.

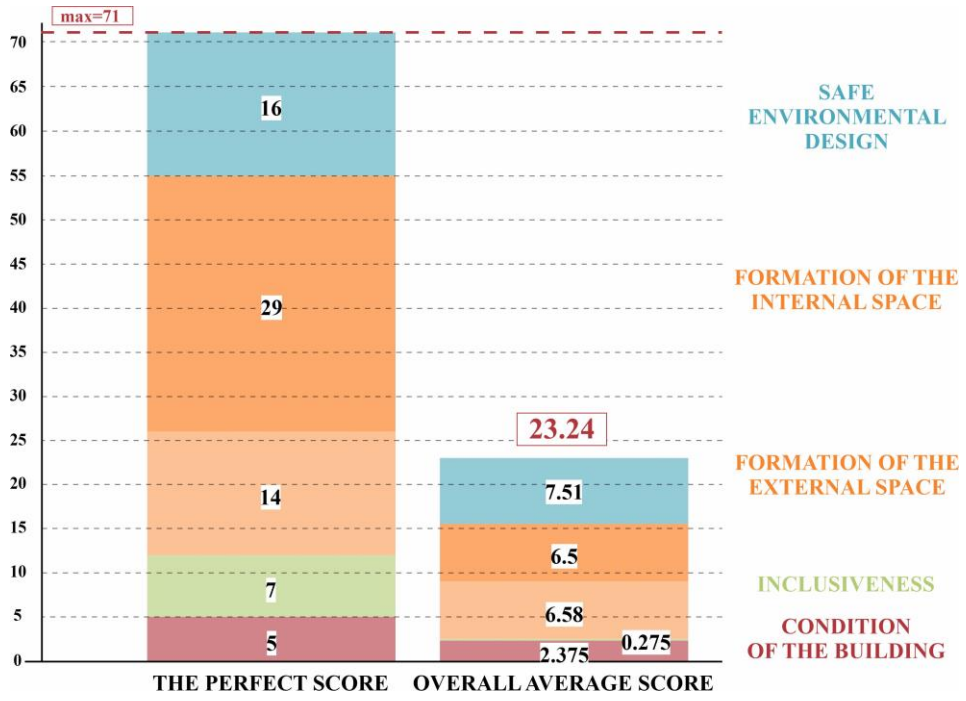

Fig. 2. Average assessment of the architectural educational space of schools in the Republic of Bashkortostan.

Throughout the analysis the results of the assessments of the educational spaces of schools, it can be revealed that only one school received half of all the points – Lyceum No. 9 in Sibay. From this, it can be concluded that most schools do not meet modern requirements and need modernization.

Safe environmental design. This principle is divided into three criteria: openness, environmental design methods and operational safety and is estimated at a maximum of 16 points. Openness consists of such criteria as the unification of the educational space, the presence of spacious public spaces, the use of glass walls and partitions. Environmental design methods consist of public control, visibility,

clarity of direction of movement, and delimitation of flows. Formation of the external/internal space. This parameter is estimated at a maximum of 43 points and consists of the formation of the internal space and territory of the school. The formation of the internal space is assessed at a maximum of twenty-nine points and includes five criteria: transformation and modularity, zoning, convergence, visual communications, coloristic design. The formation of the school territory is assessed at a maximum of fourteen points and includes four criteria: zoning, convergence, educational and experimental sites, landscaping and lighting.

Inclusiveness. This principle includes such key parameters as accessibility of movement, information support tools, vertical communications, appropriate plumbing equipment and provision of individual work with a tutor.

School in the village of Yazykovo – 19.4 points. The detailed assessment is demonstrated in Fig. 3:

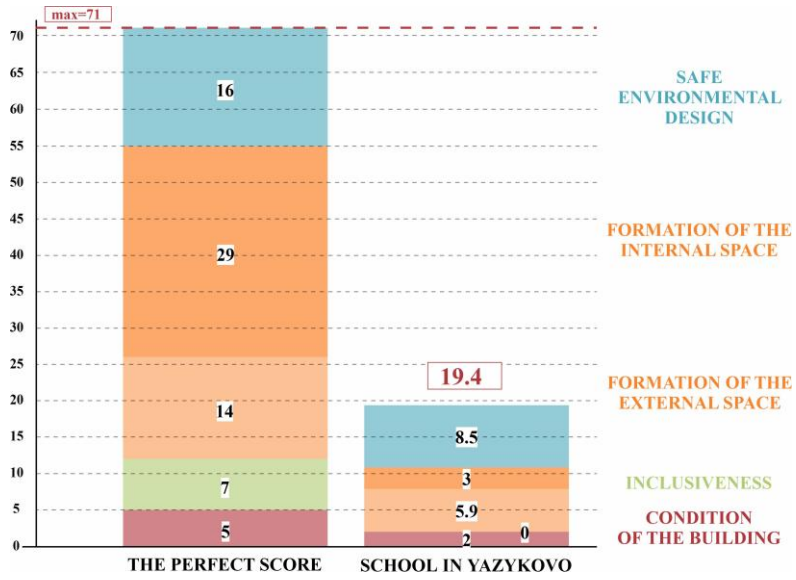

Fig. 3. Assessment of the educational environment of the school in the village of Yazykovo.

School No. 1, Yanaul – 21.6 points. Detailed assessment is demonstrated in Fig. 4:

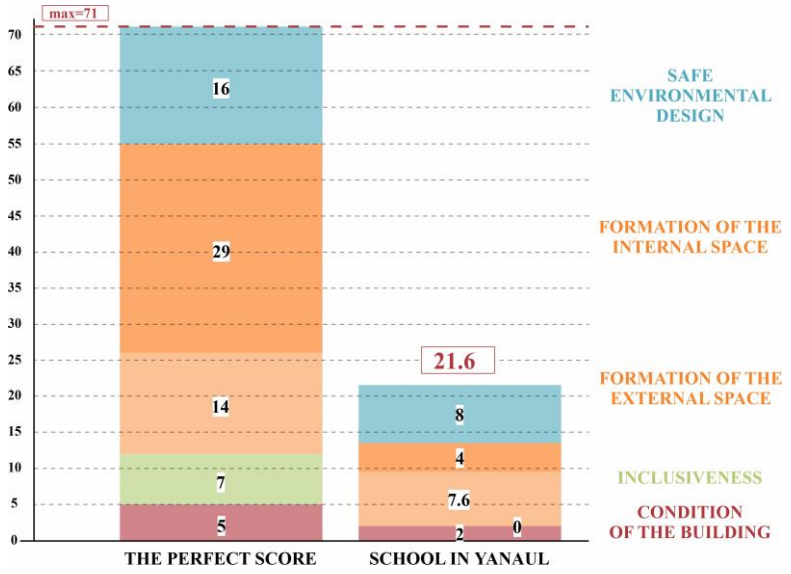

Fig. 4. Assessment of the educational environment of the school in Yanaul School No. 2, Sterlitamak – 24.4 points.

The detailed assessment is demonstrated in Fig. 5:

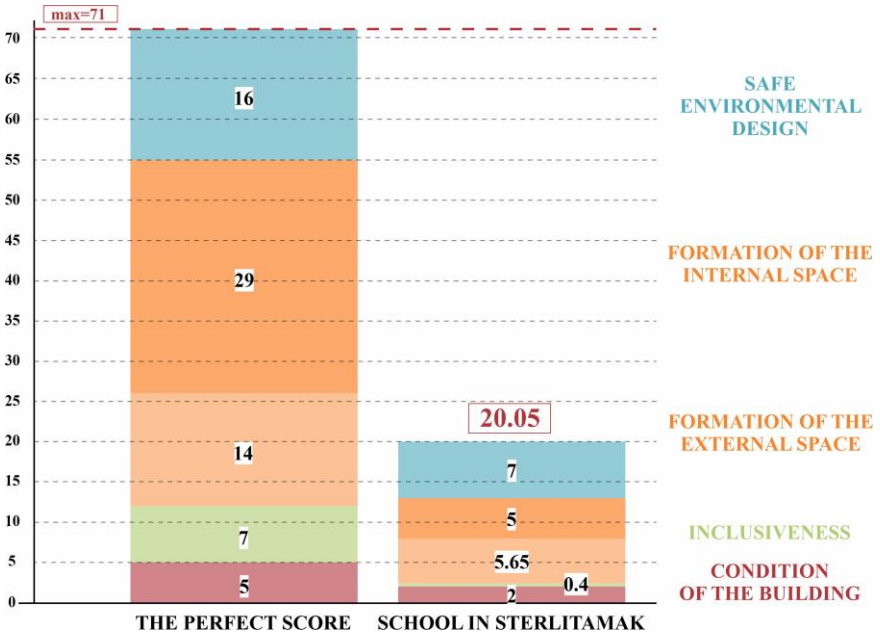

Fig. 5. Evaluation of the educational environment of the school in Sterlitamak.

Republican Engineering Boarding School of Ufa – 19.7 points. A detailed assessment is demonstrated in Fig. 6:

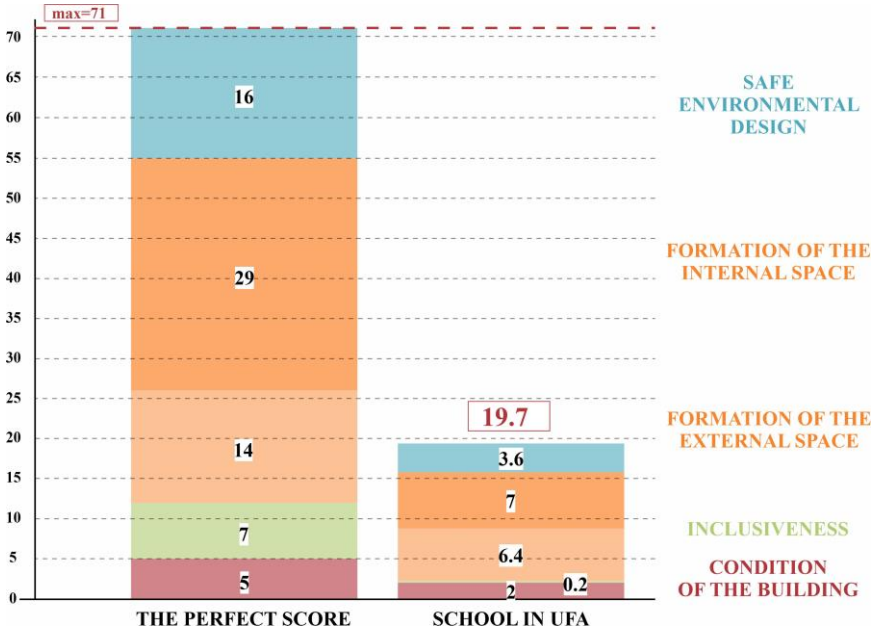

Fig. 6. Assessment of the educational environment of the Republican Engineering Boarding School of Ufa.

Gymnasium No. 1, Sibai – 37.5 points. Detailed assessment is demonstrated in Fig. 7:

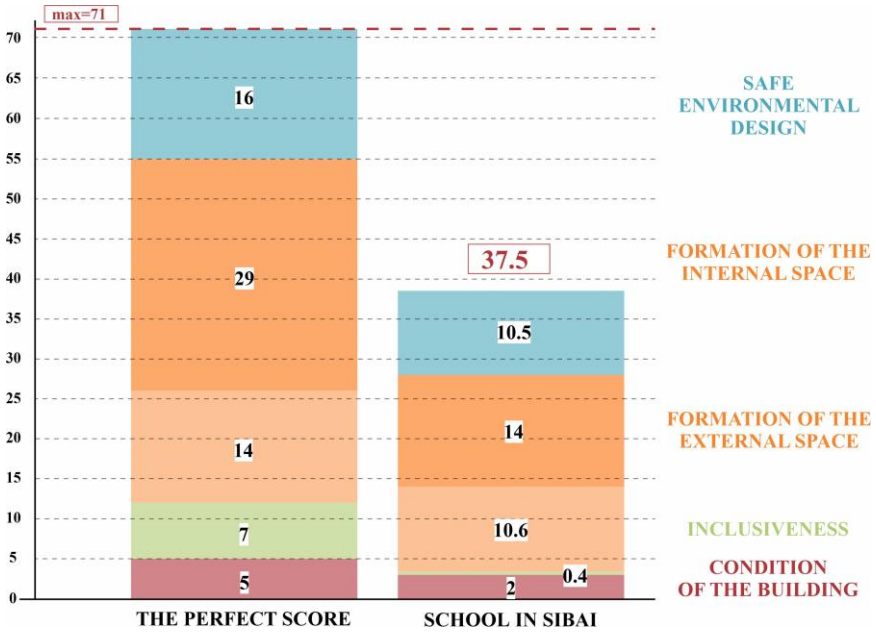

Fig. 7. Assessment of the educational environment of the gymnasium in Sibai.

Gymnasium No. 1, Agidel – 37.5 points. Detailed assessment is demonstrated in Fig. 8:

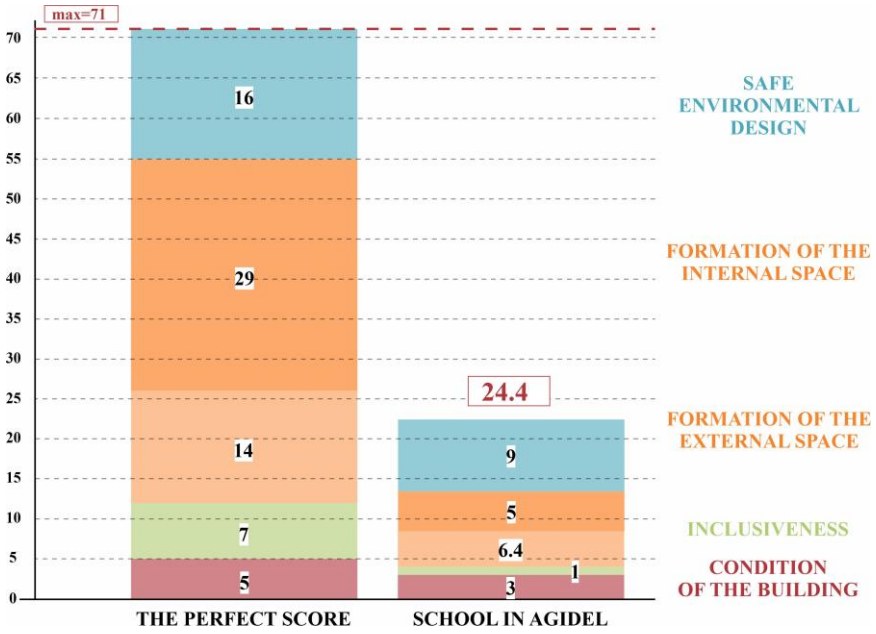

Fig. 8. Assessment of the educational environment of the school in Agidel.

Stages of the physical condition of the building. This parameter is assessed on a five-point scale, where five is an excellent condition of the building, a new facility, and zero is an unsatisfactory condition of the building, unfit for use.

Consequently, based on the assessment of the architectural space of several schools, the lowest parameter was identified – inclusivity (3.93% of the total ideal score for the inclusivity parameter) and the highest – safe environmental design (46.93% of the total ideal score for aforementioned parameter). The visual result is shown in Fig. 9.

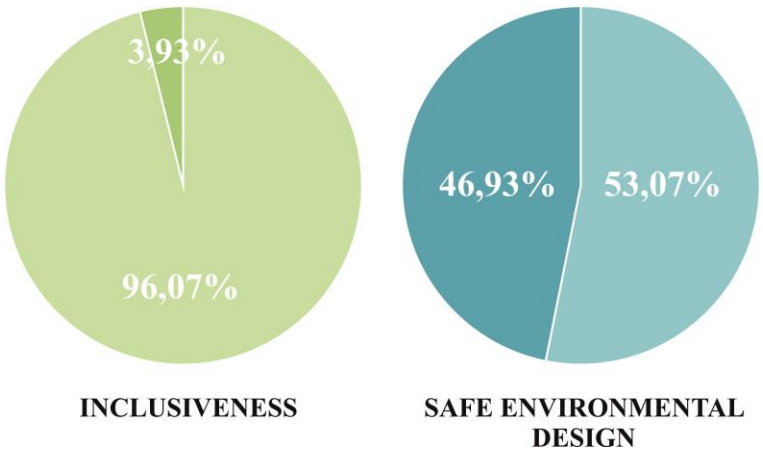

Fig. 9. The highest and lowest parameter of architectural spaces of schools.

Based on the identified assessment of the average score of the quality of the educational environment in the Republic of Bashkortostan (Fig. 2), a technical task was developed for each group of points, and four stages were identified. Each stage has its own list of recommendations depending on the number of points received (Fig. 9).

The stages of each work were calculated based on the maximum score for each principle of formation of the educational space, divided by 4. Thus, it turns out:

- safe environmental design: stage 1 from 0 to 4 points, stage 2 from 4 to 8, stage 3 from 8 to 12 and stage 4 from 12 to 16;
- formation of the internal space – stage 1 from 0 to 7.25 points, stage 2 from 7.25 to 14.5, stage 3 from 14.5 to 21.75 and stage 4 from 21.75 to 29;
- formation of the school territory – stage 1 from 0 to 3.5 points, stage 2 from 3.5 to 7, stage 3 from 7 to 10.5 and stage 4 from 10.5 to 14;
- inclusiveness – stage 1 from 0 to 1.75 points, stage 2 from 1.75 to 3.5, stage 3 from 3.5 to 5.25 and stage 4 from 5.25 to 16.

Recommendations for eliminating problems are offered from the most necessary, without which it is impossible to imagine a modern educational space, to small cosmetic works, which, in some cases, can be completed in the shortest possible time. To represent typical architectural and planning solutions for educational spaces, the Republican Engineering Boarding School and the school in the village of Yazykovo were chosen. The assessment of the architectural educational environment of the Republican Engineering Boarding School of Ufa was determined using the educational space assessment scale and interviews with the school administration.

Fig. 10. List of recommendations.

Thus, 19.2 points were scored on the developed assessment scale, where 3.6 points are safe environmental design, 7 points are the formation of the internal space, 6.4 points are the school territory, 0.2 points are inclusiveness and 2 points are the physical condition of the building.

From the data obtained, it can be concluded that this school mainly needs major repairs, it is necessary to pay attention to such parameters as safe environmental design, the formation of the internal space and inclusiveness. A more detailed assessment is demonstrated on the model of the educational space.

Based on clear requests from the administration, taking into account the requests of students, the project developed a redevelopment of existing spaces that would meet modern requirements. On the first floor, the main hall was reorganized into an information center, combined with a recreation area, since this is the first room that visitors to the lyceum enter. The rooms on the main facade side were converted into spacious cloakrooms for students, as the request for good locker rooms was the most frequent.

Also on the ground floor there was an office for meetings and events of the lyceum youth union. The students of the school would like to see a good gym, as it currently does not correspond to the number of students, but it is not possible to arrange it within the walls of the existing building, so a separate extension was proposed. In addition to a separate gym, a new sports block was equipped with modern locker rooms with showers, a gym, a coaching room and an equipment room for storing equipment. The library was moved to the left wing, as due to the location of the school and the surrounding area, the possibility of adding an extension for a gym is only on the right side.

Next, the architectural design of the school was developed (Fig. 11-18). In its development, the principles of transformation and modularity were applied, in particular, flexible space planning, visual communications, convergence and zoning. The second floor remained practically untouched, with the exception of the computer room, the recreation area in the recreation room, and the second light in the extension-gym. The remaining rooms remain classrooms and laboratory assistants. The recreation area was transformed into a soft recreation area with the possibility of organizing joint classes. On the third floor, it was decided to locate the administrative block with a separate office for the employees of the lyceum administration. Also next to it, the director's office with a new reception area was located. The assembly hall was expanded in length to increase the seating. At the request of the students, the dressing room was also enlarged. The recreation area was transformed into a recreation area with the possibility of organizing joint work outside of classes. Two new teachers' rooms with a work area and a small conference room for classes were added. A project proposal for the improvement of the school territory was developed, which considered such drawings as zoning, a covering scheme and a landscaping scheme.

A second version of the solution for the architectural space of the Republican Engineering Boarding School of Ufa was also developed. This version of the space reorganization is the easiest to implement in the realities of major repairs of schools. The integration of the external space into the interior is carried out due to the materials: wood and concrete. Preserving the textures on the facades and in the landscaping allows you to create a comfortable transition from one to another. Thus, this technique intuitively guides students around the lyceum. The architectural educational environment of the school in Yazykovo was also analyzed, problem areas were found and solutions for their improvement were put forward. The students assessed the architectural space of the school using the developed scale for assessing the quality of space. Based on the wishes of the administration and schoolchildren, and the analyzed data, a design project with visualizations was developed.

4. CONCLUSION

As a result of a comprehensive analysis of the concept of the educational environment based on world experience, the principles of architectural renovation were classified and a system of their assessment was formed, which provides a solid basis for further research and comparisons. And also on their basis, examples of solutions for educational spaces were developed.

The developed scale for assessing the spatial characteristics of the educational environment based on the analyzed world experience can be used in identifying problematic qualities and in developing design stages for a particular school.

The developed scale for assessing the spatial characteristics of the educational environment was tested on the example of seven schools in the Republic of Bashkortostan. The analysis of the situation of the educational spaces of the Republic of Bashkortostan has shown that schools have insufficient indicators responsible for the modern educational environment. The analysis of seven schools in the Republic of Bashkortostan also highlights the irrelevance of school spaces.

To complete the data, an experiment was conducted to test the methodology in real conditions, and the RILEY and Yazykovo schools were chosen as the object for field research. A comprehensive analysis of the architectural educational space using this method allowed us to obtain a more complete picture of the current state of educational institutions.

The study of the current state of educational institutions in the context of modern times and the ideal components that a modern school should have revealed the current state of schools and identified areas for improvement. The developed recommendations can serve as the basis for the terms of reference for the school administration to independently determine the depth of work and the amount of resources needed for the renovation of the school.

Variants of the architectural solution of educational spaces have been developed and a list of measures has been developed to solve the identified problems. These models take into account the basic principles of the formation of the educational environment and provide tools for their implementation, ensuring further renovation and architectural development of schools in the Republic of Bashkortostan. By implementing the proposed solutions, the quality of spending time in educational institutions will increase, and schools will acquire an aesthetically attractive learning space.

Fig. 11. Visualization of the lobby.

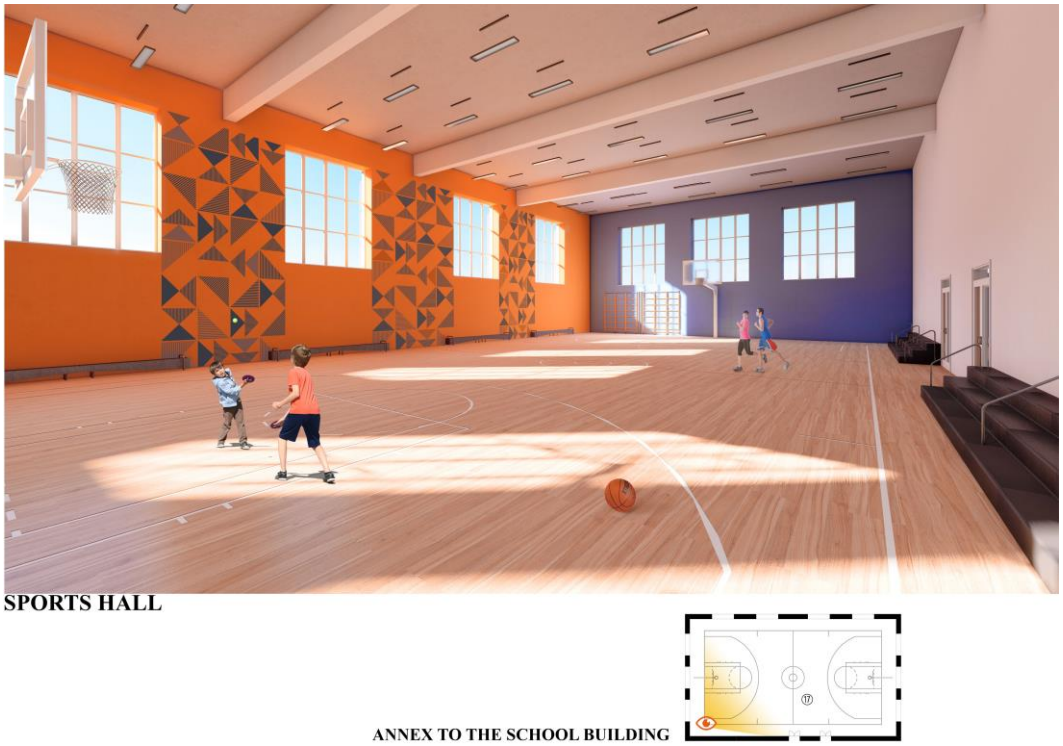

Fig. 12. Visualization of the gym.

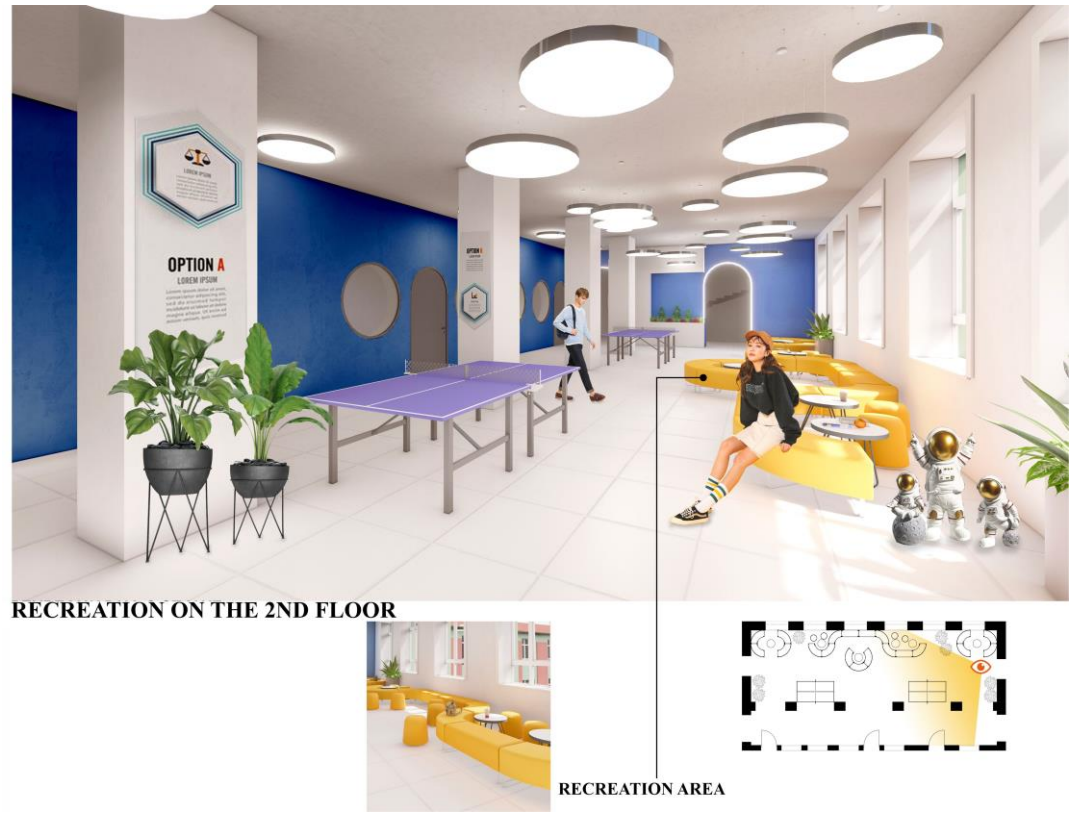

Fig. 13. Visualization of the second floor recreation are.

Fig. 14. Visualization of the assembly hall.

Fig. 15. Visualization of the hall.

Fig. 16. Visualization of the dining room.

Fig. 17. Visualization of the school exterior.

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