How to Design School Furniture for the Pandemic Period?

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Abstract With the emergence of the Covid-19 disease in 2019, the education was interrupted, and the online system was started in this process. It has been revealed that the importance of physical school spaces in education and the distance education model are not suitable for secondary education. Many of researchers reported that face-to-face education system more efficient than online education. In this paper we try to find out during pandemic period, how educational interior spaces and furniture could be change or revise? Also, in this paper the furniture design process and formation of ergonomic interiors were investigated. The risk of Covid virus transportation should be reduced with furniture design and interior space suggestions. The purpose of this paper is to identify class layout designs and minimize the contact of virus, bacteria, and germs.

1.Introduction

The pandemic period has created an extreme situation for the whole world. During the pandemic process, people are afraid of losing their life and family. Teachers are away from schools and their students. During pandemic period they teach in online classes. This process is considered as the "new normal" that can take a long time. In this study, new designs and materials were researched.

The education of millions of children around the world has been interrupted for months. The repercussions of this can be felt in economies and societies for decades. Even if children have technology and tools at home, they may not be able to learn remotely through these platforms due to factors such as family pressure to do housework, a poor environment for learning, and lack of support in education (URL1, 2020).

"Education is the most important tool of social and economic structure for the development of our country and for reaching the targeted level of life. In school age education, the most important role acquired. The primary school education is the most important part of school-age education. Primary school buildings have a special importance as the place where unique education programs are given, and the aimed information is taught. (Kose, 2010)

By using new spatial formation processes, school buildings must be flexible space formations adopted.

To prevent the interruption of education system, all measures should be taken in school buildings and indoor models suitable for pandemic conditions should be developed. "The long-term effects of the epidemic are uncertain. It is not known whether the new social behavior patterns developed by the individual will be permanent or temporary" (Koca &

Tutal, 2021).

Consider that government has invested existing school structures and buildings. It is impossible for countries to replace school buildings new structures suitable for pandemic conditions. In this paper, it is aimed, students should continue their education with new interiors and suitable furniture in accordance with the pandemic conditions in the classrooms.

2. Literature Overview

Furniture is the item that provides communication and interaction between the user, the designer, and the space (Özül & Ürük, 2021). Learning processes should also trigger interaction and creativity. School structures need to produce flexible solutions. In this context, classroom furniture should be able to adapt to new conditions and be used for this process and beyond. "The new habits and rules brought by the pandemic have created changes in the layout of the common indoor spaces. These changes in spaces have caused the concept of personal distance, which has lost its clarity until today, to reappear in our lives (Doğan, 2021).

Reducing the density of schools and integrating classes accordingly will reduce the transmission route. The buildings should be rearranged to include "social distance" and the hygiene conditions should be provided to the desired extent in the whole place. To meet these determined requirements at the desired level, interior equipment must be placed in accordance with these rules. Monitoring consumer behaviors shows that during pandemic times furniture trades are more popular than other consumer goods (Barcic et al, 2021).

"Space design should move forward with the user focus. Human is a social entity. The psychological effect of the place on the individual can be associated with the distance it establishes with other people. The ability to provide optimum movement and keep away from the feeling of being stuck affects the duration and quality of the time that the person spends in the space. The concept of social distance has been determined as 1.5 meters between people in the society. This situation has also changed the expectation of the individual from the environment and the usual space setup. It can be said that the distance of personal space has biological, physical, and psychological effects on the individual (Dogan, 2021). In pandemic conditions furniture design should obey social distance rules. This process resembles a clear similarity between well-known "Basic Design Cycle" proposed by Roozenburg and Eekels (1995).

Covid-19 has affected and continues to affect many areas with education. As our relationship with the space has changed, so have our contact, interaction, and relations with each other (Koca & Tutal, 2021). This measure, which we prefer to call 'personal distance' instead of social distance, is a distance that will create a personal protection area, not an obstacle to socialization during the pandemic period (Tan, 2020).

The most common method of Covid-19 infection is coughing, sneezing and even normal speech, which facilitates direct transmission of droplets. The best way to prevent this in schools is to create distance between students. Urban Architects' plan is to create a diagonal pattern on the classroom floor so that students can be placed in the classrooms safely. Urban Architects' plan aims at hygiene and distance. For example, the plan envisions schools adding prefabricated washing stations in the lobby and corridors to facilitate access to regular handwashing (URL2, dezeen, 2020).

However, according to Dr. Zaki, a psychologist at Stanford University: He emphasized that social distance is of vital importance in the spread of Covid-19, but that people must be connected in communication in social life, otherwise it may cause a long-term mental and physical health crisis (Zaki, 2020). Although classroom furniture is placed within the

framework of social distance rules to protect the health of students, common areas where students can socialize and engage in group work should be designed.

According to Stutsman, "We are also experiencing a mental health crisis. Symptoms of depression and anxiety are increasing. Too much stress can negatively affect a student's ability to learn. It has never been more important to consider the emotional well-being of the student in the design of learning spaces." As Angie points out, design solutions can help improve mental health throughout the pandemic in learning spaces (URL3, 2020). Flexible models can be created where students can do both individual and group work Transparent panels (glass) that act as a barrier between rows when coughing and sneezing or plexiglass) can be used.

Overall literature shows that during the pandemic period both students and teachers could affect physical and psychological symptoms. School administration should prepare ergonomic places for students which could care them from pandemic illness.

3. Methodology

In this study, schools in Ankara province were investigated, one public and private school was visited respectively in Pandemic period. All the data collected from schools, such as lux values, size of classrooms, window size, classroom furniture. During data collection laser meter and lux meter was used. Education buildings and schools are important for is essential for children's ability to learn. In this study lighting measurement was collected according to TS EN 12464-1, TS EN 12464-2 standards.

Table 1. Lighting limits required for schools according to TS-EN 12464-1

Place	lux	UGR	U_0	R_a
Classroom	300	<19	0,6	80
Blackboard	500	<19	0,7	80
Painting class	500	<19	0,6	80
Corridors	100	<25	0,4	80

Table 1. Lighting limits required for schools according to TS-EN 12464-1

School furniture is an essential part of the supply component of Education and Child health in most of country programmes. The connection between comfortable school furniture and increased learning and development of children in classrooms reveals that high quality child-friendly school furniture is essential for children's ability to learn. In addition, this research seeks to find out size of school furniture and hygienic materials.

4. Results and Suggestions

4.1 Recommended Lighting Limits

Research on educational structures and studies, students learning capacity and performance such as motivation, psychological state, intelligence not to individual factors, but to depending on the physical conditions of the place clearly shows that. Classroom light, one of the most important ambient elements of schools.

Table 2. Lighting limits compared for observed schools according to TS-EN 12464-1

According to Table 2, Public School lighting values shows that blackboard lux values less than (410 lux < 500 lux) and painting and art class lighting values less than (320 lux < 500 lux), but other important lighting values meets TS-EN 12464-1 standard, on the other

	TS-EN 12464-1	Public School	Private School
Place	lux	lux	lux
Classroom	300	320	350
Blackboard	500	410	520
Painting and art class	500	320	480
Corridors	100	130	120

Table 2. Lighting limits compared for observed schools according to TS-EN 12464-1

hand private school values meets TS-EN 12464-1 standard except painting and art class (480 lux < 500 lux). Lighting values information given school administration. Classroom designs for schools should meet with TS-EN 12464-1 standard.

4.2 Recommended Furniture for Classroom

Furniture is the most important part of classroom it should meet these requirements,
· Ergonomic
· Durable
· Antibacterial
· Suitable for children anatomy

Public school furniture commonly made by metal legs and particleboard top plates. In private school aluminum legs and MDF top plates furniture used. In public school two students sit together in one desk, but in private school one desk for one student. We recommended transparent panels for public schools (Figure 1).

Figure 1. Protection can be provided by using transparent panels in classroom spaces where distance cannot be maintained (URL1, 2020),

4.3 Recommended Classroom Layout Plans for Classroom

Public school classroom size 7m x 7m, planned for 28 students but number of students will change year by year, desks are close to each other. In private school classroom size 8m x 6m, planned for 24 students. Each classroom needs to change for pandemic conditions new classroom layout plans should be 2 times bigger of old ones (Figure 2). Educational areas should be reorganized to meet programmed needs while promoting social distancing practices. Flexible furniture can be used as much as possible. Mobile desks, stackable chairs, cleanable individual storage boxes, and mobile training boards can quickly change to create ample space. (URL4, 2021) Interiors can also be designed with greater flexibility
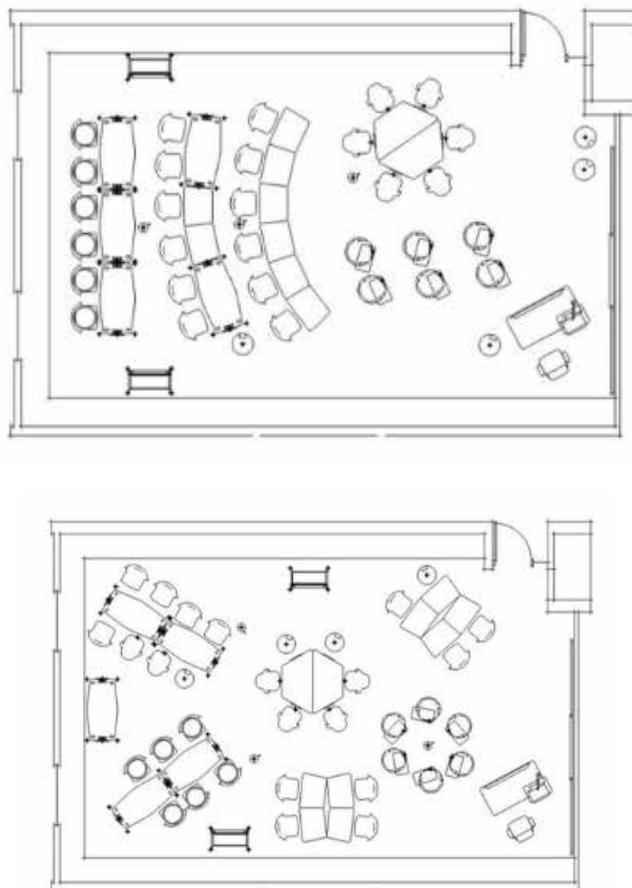
Figure 2. Flexible class system that allows both individual and group work (URL2, 2022)

in mind, using elements such as folding walls to offer multi-purpose spaces, as well as movable furniture that doubles as bookcases, for example, and portable dividers.

There will be no official "front" in the new classes (Figure 3). Instead, floor-to-ceiling interactive whiteboards will dominate. Wireless screens placed throughout the room allow teachers to present information or highlight student projects on the fly.

On the other hand, individual activities can be carried out by maintaining a minimum safety distance of two meters between students, with a personalized study area that allows for quick and easy disinfection. Healthy Classrooms can also do collective activities with mobile devices.
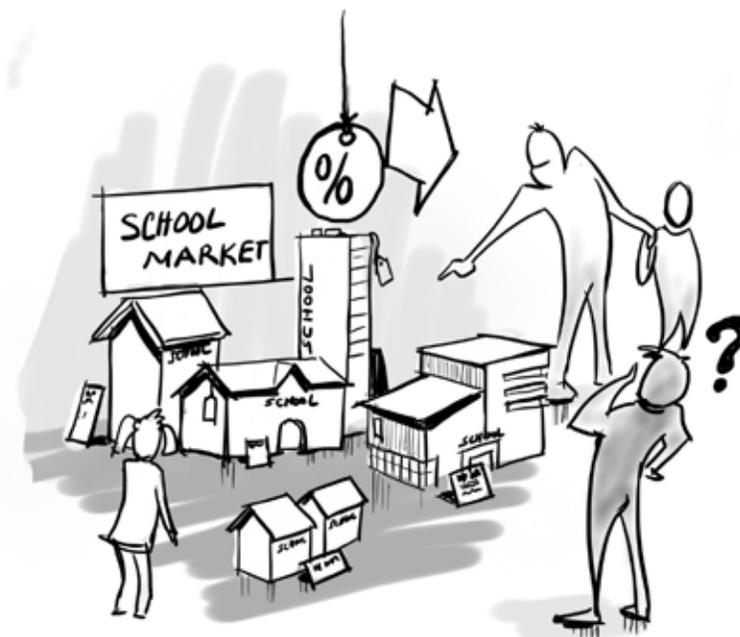

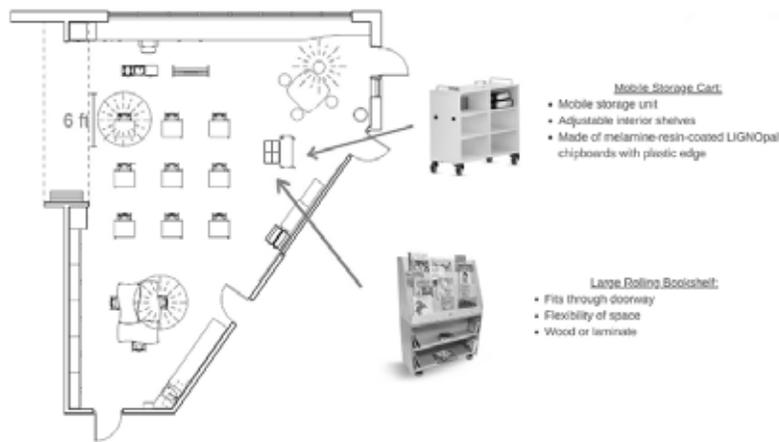Figure 3. Recommended classroom during the pandemic period (URL3, 2022)

Figure 4. Classroom and furniture design according to Pandemic period (Remenschneider, 2020).

While students are working on group projects during class hours, they can be encouraged to arrange tables, desks and/or chairs in a circle or semicircle. This arrangement is ideal for collaboration and physical distancing. Cleaning materials and furniture that are easy to transport and store will be an integral part of providing a healthy and hygienic learning environment (Remenschneider, 2020).

Hand washing stations or hand sanitizers can be placed at the entrances and exits so that students can disinfect their hands comfortably. Areas where hygiene is very important and hand washing is required in every classroom should be designed.

4.4 Recommended Materials for Classroom Furniture

Plastic materials, which we encounter in many areas in our daily life, are preferred for their easy cleaning. To give an antimicrobial effect to plastic materials, metal ion-added antimicrobial powder was added to the upper layer called dressing during production and it was tested to be antibacterial (Doğan & Pekşen, 2005, p. 65).

In the use of materials, hygienic surfaces made of HPL, melamine, MDF or metal materials and all furniture should be easy to clean. Some examples of porous surfaces that we commonly use today are drywalls, carpets, wallpapers, acoustic ceilings, tiles, bricks; These surfaces do not seem suitable for use due to their molecular structure that can harbor bacteria and viruses that pose a threat. Non-porous surfaces are denser and do not allow to absorb liquids or air, such as ceramic tiles, metal sinks, glass, metal cabinets, doorknobs and more.

The choice of materials and colors in furniture also plays a role in increasing productivity. Colors with low wavelengths such as blue have a relaxing effect on human psychology above all. The positive motivation that comes with the feeling of relaxation increases the productivity of the employee. According to the studies, it has been observed that those who work with a blue background perform twice as well in terms of developing creative ideas in the professional sense. When blue and green, which represent the peace of nature, are among the colors used in work areas, it can be noticed in a short time how the feeling of peace and spaciousness that emerges turns into high concentration, creativity, and productivity in a short time.

Studies show that being close to nature enhances students' learning abilities, showing that including plants in the classroom improves middle school students' grades and makes students and staff feel more comfortable regardless of age. The integration of plants into the interior can increase the motivation of students and help them reduce anxiety such as depression and anxiety, especially during the pandemic period (Megahed & Gehoneim, 2020).

Classroom furniture the main function of a seating element within the framework of human anthropometric measurements should also be shaped to relieve the user's fatigue (Ozel & Uruk, 2021).

4. Conclusion

Classes were started to be rethought during the pandemic period, and a self-sufficient classroom model was tried to be created by creating areas where the student can socialize with his classmates. Social distancing rules of school buildings should be use in ground maps of classrooms and corridors, students should be guided, and circulation areas should be provided. For this, a technological structure that allows the hybrid system should be created by reducing the class density. School designers must be able to guarantee safety and hygiene measures by maintaining pedagogical recommendations for collaborative work and active methodologies. But most importantly, the essence of education and what the school should do is to ensure that we maintain the relationship and bond between students and educators. In addition, children need play and physical activity areas in terms of their social and emotional development. During the pandemic
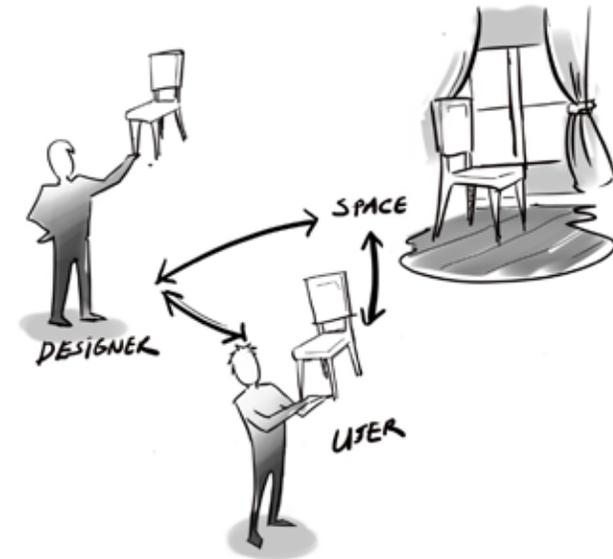
period, the distance of students from their peers with distance education caused a decrease in their social ties and negatively affected them psychologically. Furniture placed within the framework of social distance rules should also be integrated in a way that allows group work. Areas for group work should be created. The distance and contact between students can be minimized with the transparent panels positioned on the tables. Individual activities can be carried out by maintaining a safe distance between students. Collective events can also be done with mobile devices. In addition, furniture that can be suitable for working places in the open area can be produced and used both indoors and outdoors.

Nanotechnology plays a vital role in the treatment of anticipated and unexpected infectious diseases caused by bacteria and viruses. Hybrid antimicrobial coatings containing copper, silver and zinc cations show great effects against viruses and microbes (Balasubramaniam, et al., 2020).

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