Ergonomic Evaluation and Rearrangement of Student Desks and Tables in Secondary School, Practice in Ankara Region

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Abstract

The purpose of this study is to discuss the suitability of ergonomic criteria of student desks and tables in secondary school. Anthropometric measures are structured according to nation, region, gender, age, body structure, nutrition, physical activity, and even economic and social status. Their comfort, physical health, well-being and performance in the environments where people are located can be increased by designing the tools-materials and equipment in accordance with the relevant organs and features of the human body.

In particular, this is a protective posture that spends most of its time on desks and tables. In this way, it is aimed to design the school desks and tables according to anthropometric measurements of our country students. Within the scope of the research, a total of 700 students, 324 girls and 376 boys, who still continue their education and who do not have a physical disability, are working in the Şehit Şükrü Can Kayadibi Secondary School from Ankara-Altındağ district. In Ankara-Altındağ Districts, it tried to be presented at the desks and tables design stage suitable for its students.

1. Intrroduction

In recent years, 41 separate school models have been developed by the Ministry of Education, which are in the search for an architectural style and try to give weight to local motifs, as well as school types that can be considered as concrete reflections of longing for the past (Akın, 1998). In addition to such initiatives, which can be evaluated positively in terms of getting rid of uniformity, but have many aspects that need to be criticized, it is a positive development that the private schools are painted in a way that will make the schools look warmer (Erdoğan, 2001). Schools are organizations that produce people, and people deserve the best of everything. Environmental factors in childhood; school building, learning environment directly or indirectly affect the child during his/her life (Bıldır, 1995). Therefore; planners, architects, school administrators, teachers should not forget that the school environment contributes to the development of

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the child's aesthetic understanding (Panagıotopoulou, 2003). Only those who live know the effect of the white or gingham blue, pink covers and curtains on the child, and the happiness of children, which are made with the attempt of the teacher on wooden desks that are worn out and whose color can no longer be selected. Reviewing the school and classroom environment with an understanding that takes human as a primary value is a necessity of modernity, as well as using resources wisely, ensuring efficiency and effectiveness is also a requirement of science.

The approach that will contribute to the consideration of school and classroom environments in the context of these two values is ergonomics. Ergonomics is a word derived from the ancient Greek "ergon" meaning work and "nomos" meaning natural law or order. In general, ergonomics can be defined as the scientific relationship between human and work environment. In this respect, another field of science that should be mentioned is anthropometry. Anthropometry is derived from the ancient Greek "anthropo" meaning human and "metron" meaning measure. Anthropometry is a special branch of science that deals with the dimensions of the human body (Kayış, 1987). Ergonomically, anthropometry can be divided into static anthropometry and dynamic anthropometry. Static anthropometry deals with the metric values of people's static postures and sitting (Özbilgin, 1986).

Making ergonomic arrangements in educational environments will increase the quality and efficiency of educational environments, make it easier for teachers and students to have a learning experience in a better environment and to gain experience from permanent learning. In addition, it should be noted that ergonomic regulations will also prevent health problems and accidents. For this reason, the anthropometric measurements of the students will be established in our schools according to these measurements, and the arrangement of the desks and tables at each grade level in the secondary school according to anthropometric factors and the review of the current ones will provide positive working conditions. For this purpose, the main purpose of this study is to examine the desks and tables of 5th, 6th,7th and 8th grades in terms of compliance with ergonomic rules.

2. Material and Method

2.1. Material

This study was carried out in the Directorate of Şehit Şükrü Can Kayadibi Secondary School in Altındağ District and affiliated with the Altındağ District Directorate of National Education, based on the "Permission and Application Directive for research and research support to be carried out in schools and institutions affiliated to our Ministry" with the permission of the Ankara Provincial Directorate of National Education and the approval of the Governorship, permission was obtained to conduct research under the supervision of the School Principal in a manner that would not disrupt education and training. A total of 700 students participated in this study, taking all students from each grade including 5th, 6th, 7th and 8th grades in secondary school. First of all, oral explanations about the research and measurements to be taken were made by physical education teachers to the students participating in the study.
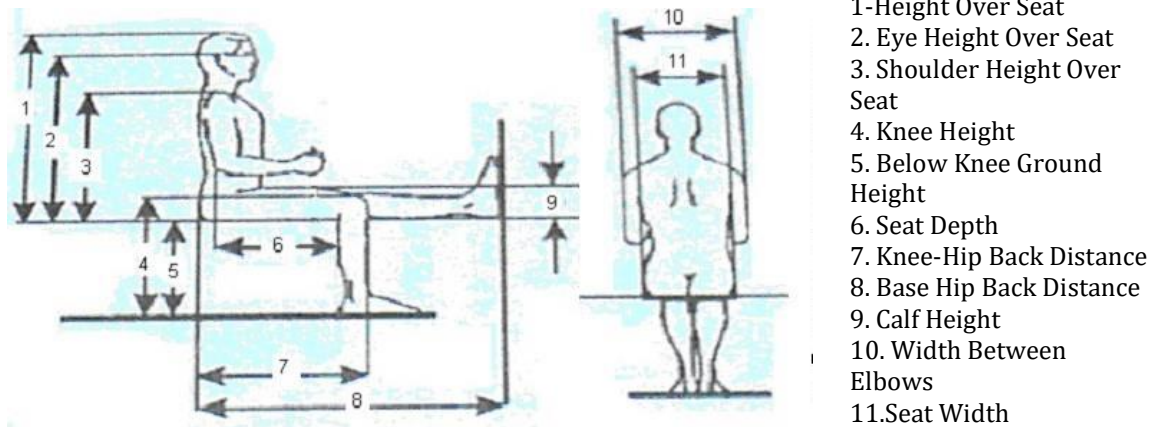
First of all, the weight and height of the students in shoes and clothes were measured. Then, the student sitting on the seat, the height above the seat, the height above the seat, the height of the shoulder above the seat, the height of the knee from the ground, the height below the knee, the depth of the seat, the back of the knee-hip distance, the width between the elbows and the seat width are measured and written on the chart. To measure weight, maximum 200 kg and 50gr precision weighing (Yunmai Blance brand), and 1 meter tape measure were used.

Chart 1. Anthropometric Measurement Record Table

School: Şehit Şükrü Can KAYADİBİ SECONDARY SCHOOL						1	2	3	4	5	6	7	8	9	10	11
Student	Name-Surname	Class	Gender	Weight	Height	Height Over Seat	Eye Height Over Seat	Shoulder Height Over Seat	Knee Height	Below Knee Ground Height	Seat Depth	Knee Hip Back Distance	Base Hip Back Distance	Calf Height	Width Between Elbows	Seat Width
1			Boy													
2			Girl													
3			Boy													
4			Girl					z								

Anthropometric measurements were recorded in different charts for each grade and branch.

Figure 1. Measurements and Dimensions Used in Anthropometric Research

1-Height Over Seat
2. Eye Height Over Seat
3. Shoulder Height Over Seat
4. Knee Height
5. Below Knee Ground Height
6. Seat Depth
7. Knee-Hip Back Distance
8. Base Hip Back Distance
9. Calf Height
10. Width Between Elbows
11.Seat Width

2.2. Method

In the study, free measurement method, which is one of the direct measurement methods, was used to determine anthropometric measurements. This method is widely used due to its economical and usefulness.

By using the percentile(percentile) values calculated according to anthropometric data obtained as a result of measurements made in the study, the design

dimensions of the desks and tables of the students were revealed and compared with the design dimensions of the desks and tables, currently used.

2.3. Findings and Discussion

The research was carried out on students (5th, 6th, 7th and 8th grades) studying in secondary schools. The anthropometric measurements of the 5th students and the anthropometric measurements of the 8th grade students are getting difficult in other desks and tables, and it turns out that it is not ergonomically suitable.

It is understood from the research that the structure, equipment and tools of the secondary school students were designed without taking into account their anthropometric measurements. For this reason, the anthropometric measurements of the students should be determined with more detailed studies and ergonomic designs should be made accordingly. In fact, considering that the anthropometric measurements of the students will change over time, researches should be done on this subject at certain time intervals.

Descriptive and percentages of the dimensional measurements of the students in the standing and sitting position covered by the research are given in the charts below. In these charts, arithmetic mean, standard deviation, maximum and minimum values of male and female students regarding the measurements taken in standing and sitting position are presented. In the ergonomic design of school rows and tables, students' body size, hip-popliteal opening while sitting will be taken as an important criterion. In addition, students ' shoulder width, back-of-knee height, hip-knee length, knee height while sitting, and height lengths are body measurements that can help in the design of rows and tables.

Chart 2. Gender Distribution of Students

Gender	N (number of people)	%
Girl	324	46,3
Boy	376	53,7
Total	700	100

Chart 3. Number and Percentage of Students by Grade

Grades	N (number of people)	%
5th Grade	211	30,1
6th Grade	159	22,7
7th Grade	151	21,6
8th Grade	179	25,6
Total	700	100

Chart 4. Weight (kg) Statistics of Students Participating in the Study

Grades	Weight (kg)				
	N	Average	Standard Deviation(±)	Minimum	Maximum
5th Grade	211	41,39	11,51	26,8	81,9
6th Grade	159	43,27	10,69	25,1	83,1
7th Grade	151	49,09	11,11	26,2	85,3
8th Grade	179	55,11	10,99	31,5	84,1

Chart 5. Students' Height Statistics

Grades	Height (cm)				
	N	Average	Standard Deviation(±)	Minimum	Maximum
5th Grade	211	143,50	8,01	119	169
6th Grade	159	149,20	8,55	116	171
7th Grade	151	154,98	8,41	131	178
8th Grade	179	160,06	7,88	139	181

Chart 6. Students' Height Over Seat Statistics

Grades	Height Over Seat				
	N	Average	Standard Deviation(±)	Minimum	Maximum
5th Grade	211	75,77	5,92	47	88
6th Grade	159	76,69	5,01	53	88
7th Grade	151	79,98	5,61	41	91
8th Grade	179	82,19	4,08	51	92

2.4. T Test Result According to Grades

Chart 7. T Test Chart

Anthropometric Measurements	F	Sig.
Weight	2,286	,125
Height	13,089	,000
Height Over Seat	,049	,777
Eye Height Over Seat	,385	,546
Shoulder Height Over Seat	1,507	,234
Knee Height	16,302	,000
Below Knee Ground Height	4,960	,033
Seat Depth	1,086	,301
KneeHip Back Distance	4,175	,040
Base Hip Back Distance	22,086	,000
Calf Height	,348	,538
Width Between Elbows	13,876	,000
Seat Width	,197	,661

When the T test table is examined, it is seen that there is a significant difference between different gender groups in terms of height, knee height, below-knee height, knee-hip distance, base-hip distance, and elbow widths.

In other words, there are differences between male and female students in terms of height, knee height, below-knee height, knee-hip distance, base-hip distance and elbow width (At 5% meaning level).

2.5. Anova Test Result

Chart 8. Comparison of Averages by Grades

Antropometrik ölçümler	F	Sig.
Anthropometric Measurements	190,217	,000
Weight	463,377	,000
Height	248,301	,000
Height Over Seat	269,277	,000
Eye Height Over Seat	198,503	,000
Shoulder Height Over Seat	372,002	,000
Knee Height	211,912	,000
Below Knee Ground Height	177,402	,000
Seat Depth	159,014	,000
KneeHip Back Distance	180,222	,000
Base Hip Back Distance	22,518	,000
Calf Height	94,741	,000
Width Between Elbows	22,652	,000
Seat Width		

When the Anova table is examined, it is seen that there is a significant difference between students in different grades (5th, 6th, 7th and 8th grades) in terms of all physical characteristics.

2.6. Knee Height- Under- Table Height

Chart 9. Under-Table Height Average

	Average
Under-Table Height	47,83

As a result of the calculations, the average under table height of all classes was 47,836. When the value in question is compared to the knee height of the students,

Chart 10. Knee Height Average

	N	Average	Standard Deviation(±)
Knee Height	700	46,11	5,49

Chart 11. T Test Table Knee Height Average

Test Value = 47,83			
	T	df	Sig. (2-tailed)	Average Difference
Knee Height	-12,98	700	,000	-2,13

Looking at the p value in the T test table, it seems that it is less than 0.000, that is, 0.05, in other words, there is a significant difference between the averages. Students ' knee heights are shorter than under-table heights.

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2.7. Comparison of Seat- Below-Knee Height by Grades

Chart 12. Seat- Below-Knee Height by Grades

Grades	Below Knee	Seat Height	Difference
5th Grade	39.22	38.17	+1.05
6th Grade	39.98	40.01	-0.03
7th Grade	40.89	41.25	-0.36
8th Grade	42.01	42.23	-0.22

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.942	.916	.903	.66958

The relationship between seat height and knee height can be explained statistically by 91.6%.

3. Conclusion

Since each student will use it with their own classmates, preparations for activities in the classroom will be done more properly. Since each student will use his / her own class, it is ensured that the students study healthier and more efficiently according to the anthropometric measures of this class.

Since the length of the sinks in the school is different for each class, the cleaning needs of the students will be difficult for students of different heights. For this reason, sink heights should be made according to the height of the students of that class on the floor where each class is located.

In secondary schools, separate anthropometric measurements of girls and boys should be taken for each grade and separate desks and tables should be designed for girls and boys according to these anthropometric measurements.

Figure 2. 5th and 6th Grades Desk and Table Measurements

Figure 3. 7th and 8th Grades Desk and Table Measurements

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