

Main Requirements for Designing School Backpacks for Students in Uzbekistan

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Received: 29 March 2025; **Accepted:** 25 April 2025; **Published:** 27 May 2025

Abstract: This article explores the key requirements for designing school backpacks for students attending educational institutions in Uzbekistan. It highlights essential ergonomic, hygienic, aesthetic, safety, and psychological considerations. Furthermore, it examines modern examples of backpack designs based on technological advancements, analyzes international practices, and discusses how they can be adapted to the needs of Uzbek students. In addition, research conducted by the author to determine the proportion between school backpack weight and student body weight in schools has also been highlighted. The article serves as a practical guide for manufacturers, designers, and educators involved in the design of school equipment.

Keywords: Backpack, ergonomics, student, design, load, health, safety, hygiene, aesthetics.

Introduction:

Alongside educational reforms in Uzbekistan, increasing attention is being paid to student safety, physical well-being, and comfort. One of the most essential daily-use items for students is the school backpack since they can distribute the load symmetrically. Currently, the number and types of personal belongings of schoolchildren, such as electronic gadgets, lunch boxes, and modern stationery and other items are increasing. In accordance with this process, the weight of students' loaded backpacks is also increasing. The results of Mackie H.W and his team's investigation on four different backpack structures showed that backpack weight has great on stress and pressure on shoulders. Poorly designed backpacks can lead to spinal issues, shoulder strain, muscle pain, fatigue, and hygiene problems.

Backpacks, especially those intended for elementary school students, must be lightweight, ergonomically shaped, and adapted to the students' physical development. In Uzbekistan, approaches to this issue are still important. Therefore, when designing school backpacks, it is crucial to adhere to international

standards, health and safety norms, and psycho-pedagogical requirements.

Main body

1. Ergonomic Requirements

Ergonomics is the science of designing products by taking into account the human body's structure, movement, and health. For a backpack to be ergonomic, it must meet the following criteria:

- **Weight:** Weight is controversial issue, although according to medical studies 10% of bodyweight has been recommended. The optimal weight of the school backpack depends on several factors. The most important factors are: 1) weight and physical fitness of the child; 2) time and distance bag is carried; 3) quality and design of the backpack and 4) type of transport. The empty backpack weight should be: Grades

1–4: 500–800g; Grades 5–9: 800–1000g; Grades 10–11: 1000–1200g. According to the recommendations provided by the Sanitary-Epidemiological Welfare and Public Health Committee of the Republic of Uzbekistan: 'Schoolbags chosen for students should be lightweight

and have an orthopedic design. The weight of the bag should not exceed 10–15% of the child's body weight

- Shoulder Straps: They should be at least 4 cm wide, made of soft materials, and have adjustable lengths.
- Back Panel: It should be anatomically shaped to support the spine and provide proper posture.
- Waist Belt: A waist strap helps distribute the weight evenly and reduces shoulder strain.

Uzbek scholar Tuxtayev A.X. (2021) conducted a medical-ergonomic study showing that poorly designed backpacks contributed to spinal misalignment in children under 10. Observations revealed that 1 in 3 students reported back pain linked to backpack use. In another 2022 study by the Department of Hygiene at Tashkent Pediatric Medical Institute, 42% of 150 elementary students were found to carry backpacks exceeding recommended weight standards.

2. Hygienic Requirements

Backpacks are in daily contact with the student's body and clothing. Thus, the following points are essential:

- Ventilation: The back should allow airflow to prevent overheating and sweating.
- Materials: Backpacks must be made of eco-friendly, hypoallergenic, and easily cleanable materials. The materials should also be lightweight and not easily absorb various contaminants.
- Interior Hygiene: The lining should be smooth, dust-resistant, and not designed to store food or other contaminating items.

In 2020, hygiene specialist Kholmatova D.S. found that backpacks with poor ventilation caused skin rashes, especially on the back. She concluded that natural materials offer better hygiene outcomes compared to synthetic ones.

3. Aesthetic and Design Requirements

Students, especially younger ones, care about the visual appearance of their backpacks. Designers should consider:

- Age-appropriate colors: Bright, soft-toned colors and cartoon characters appeal to young children.
- Gender differences: Design features (motifs, colors) should reflect the interests of boys and girls.
- Minimalism: Avoid excessive decorations or non-functional components that increase weight.

4. Safety Requirements

Safety-oriented elements in backpacks include:

- Reflective Strips: Especially useful for children walking to school in the early morning or late afternoon.
- Durability: Seams and zippers must be secure and

resistant to tearing.

- Zippers and Buckles: Should be easy for the child to operate, but not prone to accidental opening.

In 2023, under the leadership of Professor S.S. Jo'rayev at the Bukhara Engineering-Technological Institute, a project was developed to create ergonomically designed experimental backpacks. These models, weighing only 650–800 g, were proven to have no negative effect on children's posture.

5. Pedagogical and Psychological Approach

Students see their backpacks not just as tools but as expressions of their personality. Thus:

- Student Involvement: Design processes can involve surveys or design classes where children participate in creating their own models.
- Educational Value: Backpacks can help teach hygiene, organization, and a sense of responsibility.

In their research report, Mackenzie W.G and colleagues recommend using the User-Centered Design (UCD) method in designing ergonomically comfortable backpacks that balance the load on the student's body and reduce the risk of various harmful factors. The UCD method involves designing backpacks based on students' specific needs—such as daily load, body structure, body weight, and required functional volume. In this method, not only field specialists but also users themselves participate in the design process, with particular attention paid to the backpack usage cycles

RESULTS AND DISCUSSIONS

In order to determine the weight of backpacks carried by schoolchildren in Uzbekistan, measurement studies were conducted in three schools in Tashkent. During the course of one week, the students' backpack weights were measured based on their class schedules. From the collected data, the minimum and maximum backpack weights were identified, and the average weight and the widest range were calculated based on the number of students. Additionally, the students' body weights were measured, and their average weight and the broadest range were established. Based on these results, the average percentage of backpack weight relative to students' body weight was calculated. The findings showed that the backpack weight amounted to 13.18% of body weight for 1st-grade students, 11.6% for 2nd grade, 12.2% for 3rd grade, and 11.5% for 4th grade. In some cases, however, 1st-grade students were found to be carrying backpacks equal to 18.6% of their body weight, 2nd-grade students 16.5%, 3rd-grade students 16.2%, and 4th-grade students 14.2%. These figures exceed the 10% threshold recommended by experts, and it has

been scientifically proven that carrying such heavy backpacks for extended periods can lead to shoulder pain and changes in the circulatory system.

CONCLUSION

Designing school backpacks is not merely about producing a bag—it is about creating a product that affects a child's physical development, mental well-being, and academic performance. Manufacturers, designers, and educators must collaborate to develop backpacks that are aligned with both international standards and national needs. School backpacks are an integral part of the learning environment and serve as important tools in shaping children's physical development, hygienic habits, and aesthetic awareness. In designing highly ergonomic and safe backpacks for schoolchildren, the use of the User-Centered Design method mentioned above is considered highly effective.

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