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The Impact Of Hot Weather Conditions On The Efficiency Of Lesson Assessment During Outdoor Physical Education Lessons

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Abstract: This article examines the impact of climatic factors on the effectiveness of physical education lessons conducted outdoors in three regions of Uzbekistan: Termiz, Fergana, and Karakalpakstan (Nukus). The analysis is based on meteorological indicators from the 2023–2024 academic year (air and soil temperature, humidity, precipitation, wind speed) and the physical fitness results of students in grades 5–9. Findings show that during warm spring and autumn periods, high temperatures and low humidity may lead to dehydration, fatigue, and reduced learning performance among students. The article provides methodological recommendations, including scheduling PE lessons during cooler hours, choosing climate-appropriate sportswear, and preventing heat-related health risks.

Keywords: Hot climate, physical education, outdoor lessons, students' physical fitness, meteorological conditions, learning efficiency.

INTRODUCTION:

When organizing physical education and sports classes in the open air, the weather has a great influence on the effectiveness of the lesson. Therefore, when organizing classes, it is the force of air that exerts pressure on the earth's surface and everything on it.

The atmospheric pressure of climatic regions differs significantly under the influence of temperature, altitude, movement of air currents and other factors.

In particular, according to the classification of P. B. Alisov, adopted in Russia, four main climatic zones are distinguished in each hemisphere of the Earth depending on the predominance of air masses. The names of the zones correspond to their geography:

equatorial;

tropical;

temperate;

polar (arctic and antarctic) regions.

Since the sun does not heat the hemispheres evenly, the boundaries of climatic zones change depending on the seasons. As a result, areas are formed that are sometimes affected by hotter or colder, and sometimes warmer air masses. The climate in such a region is called transitional. The names of the transition regions have the Latin prefix "sub" ("under"):

subequatorial;

subtropical;

called subarctic and subantarctic.

The temperature throughout the year ranges from +24 to +30 °C, the humidity is very high (80-90%), it rains in the afternoon, and thunderstorms are frequent.

This type of climate is widespread south and north of the equator. The boundaries of the subequatorial region are wider on the continents. This region has two seasons:

a summer rainy season, when monsoons bring warm and humid air from the equator.

A dry winter season is characterized by dry tropical winds blowing from the continents.

Therefore, in summer, the air humidity is 80%. In

winter, it rains twice and there is almost no precipitation. Depending on the season and proximity to the ocean, the average temperature varies from +22 to +35 °C.

Tropical climatic conditions extend in the Southern Hemisphere in the form of a continuous strip, and in the Northern Hemisphere over India and Indochina - they are interrupted by the territory of the subequatorial region.

In the tropics, seasonal temperature changes are much more pronounced than at the equator. In continental regions, they can vary from 0 °C in winter to +45 °C in summer. Due to the high atmospheric pressure, there is little rain here. Therefore, the nature of the tropical regions, due to their hot climate, is mainly represented by deserts and semi-deserts, where the development of flora and fauna is low.

Subtropical climatic conditions are formed under the influence of seasonal alternations of tropical and temperate air masses. In summer, winds blowing from the tropics bring dry and hot weather, and in winter, humid and cool winds blow from temperate regions.

Four types of climate are distinguished in this climatic region:

Mediterranean - the most favorable for humans: not very hot summers (+22...+27 ° C) and warm winters (+up to 10 ° C). Most of the precipitation falls in the winter.

Mainland (continental) - distributed in North America and Central Asia. In summer, the air temperature is around +30 ° C, and in winter it can drop below zero. The humidity level varies sharply depending on the season - 30-40% in summer, up to 70% in winter. Snow sometimes falls in winter, but it does not last long. This climate is characterized by a high prevalence of steppes and semi-deserts due to low soil moisture.

Our data show that in the southern regions of Surkhandarya, Kashkadarya, Bukhara, Navoi, Khorezm and Karakalpakstan, air temperatures in the summer rose to +40...+45 °C and in the winter dropped to -10 °C. Especially in the spring months of the academic year, the average relative humidity in Surkhandarya region decreased from 70% to 25%, and from March to May, the temperature rose to +24...+35 °C, while in the autumn months of September-November, the temperature rose to +16...+35 °C.

Of course, in such conditions, there are certain difficulties in organizing physical education classes with schoolchildren.

In the spring and autumn break seasons, that is, in the I and IV quarters, the warming of weather conditions leads to a decrease in the water content of students' bodies during the effective organization of educational classes with them. Therefore, it is necessary to maintain the water content of the body at a certain level, ensure that sportswear is worn in accordance with the season, and prevent heatstroke.

We conducted pedagogical experiments in the Nukus, Fergana and Surkhandarya regions of Karakalpakstan.

Accordingly, the Hydrometeorological Service Agency under the Ministry of Ecology, Environmental Protection and Climate Change of the Republic of Uzbekistan studied the weather forecast for the 2023-2024 academic year in the Nukus, Fergana and Surkhandarya regions of Karakalpakstan and conducted pedagogical experiments.

We have provided the weather forecast for the 2023-2024 academic year from the Hydrometeorological Service Agency.

Table 1

Data on weather indicators for the city of Termez in the 2023-2024 academic year.

By Months, Decades	Air temperature /degrees/			Soil temperature /degrees/		Relative humidity /%/		Precipitation amount /mm/	Wind (m/s q m)	Soil temperature at a depth of 10 cm /degrees/
	Average	Max	Min	Max	Min	Average	Min			
Termez										
September 2023.										
1	+35	+43	+17	+50	+20	34	11	0	2.8	+25
2	+33	+42	+16	+48	+18	34	11	0	2.8	+22

3	+31	+42	+16	+50	+20	34	11	0	2.8	+19
By month	+33	+41	+15	+50	+20	34	11	0	2.8	+22
October 2023.										
1	+29	+35	+15	+30	+12	41	14	0	3.7	+22
2	+26	+34	+14	+30	+12	41	14	0	3.7	+19
3	+23	+34	+13	+28	+10	41	14	6	3.7	+16
By month	+25	+34.5	+11	+30	+12	41	14	6	3.7	+19
November 2023.										
1	+19	+28	+13	+20	+5	60	20	0	3.5	+15
2	+16	+28	+10	+18	+5	64	21	7	3.5	+12
3	+13	+27	+8	+20	+5	68	23	8	3.5	+9
By month	+16	+27.9	+8	+20	+5	64	21	7.5	3.5	+12
December 2023.										
1	+12	+23	+5	+10	+2	70	23	0	4.2	+8
2	+10	+23	+3	+12	+2	71	24	2	4.2	+6
3	+8	+22	+2	+12	+2	72	24	4	4.2	+4
By month	+10	+23	+4	+12	+2	71	24	3.5	4.2	+6
January 2024.										
1	+9.2	+21	+0.4	+10	+2	70	23	0	3.5	+5
2	+10.7	+22	+1.5	+10	+2	72	24	5	3.5	+4
3	+6.8	+22	-1.2	+8	+2	80	27	14	3.5	+3
By month	+8.4	+22	+1	+10	+2	81	27	9	3.5	+4
February 2024.										
1	+10	+23	+3	+8	+2	65	22	10	3	+6
2	+11	+24	+4	+10	+2	66	22	9	3	+5
3	+12	+25.5	+5	+10	+2	67	22	9	3	+4
By month	+11	+25.9	+4	+10	+2	66	22	10	3	+5
March 2024.										
1	+15	+26	+7	+16	+5	60	20	12	3	+8
2	+19	+29	+9	+18	+6	60	20	10	3	+10
3	+23	+30	+10	+18	+6	60	20	12	3	+12
By month	+20	+30.4	+10	+18	+6	60	20	12	3	+10
April 2024.										
1	+24	+31	+15	+20	+9	35	12	5	4.3	+12
2	+26	+33	+17	+22	+10	37	12	6	4.4	+14
3	+28	+34	+19	+22	+10	39	13	3.6	4.5	+16
By month	+31	+33.	+17	+22	+10	37	12	5	4.4	+14

		9								
May 2024.										
1	+24	+35	+11.7	+28	+16	38	13	4	3	+18
2	+27	+38	+13	+30	+18	40	13	3	3	+20
3	+28	+38	+15	+30	+18	39	13	3	3	+22
By month	+26	+38.8	+11.7	+30	+18	40	13	3.5	3	+20

Table 2

Data on weather indicators for the city of Fergana in the 2023-2024 academic year.

By Months, Decades	Air temperature /degrees/			Soil temperature /degrees/		Relative humidity /%/		Precipitation amount /mm/	Wind (m/s q m)	Soil temperature at a depth of 10 cm /degrees/
	Average	Max	Min	Max	Min	Average	Min			
Fergana										
September 2023.										
1	+30	+36	+15	+28	+16	25	9	2	2.8	+26
2	+28	+35	+14	+28	+16	27	9	2	2.7	+24
3	+27	+35	+13	+26	+14	29	10	1	2.6	+22
By month	+28.8	+35	+13.7	+28	+16	27	9	2	2.7	+24
October 2023.										
1	+16	+30	+11	+22	+12	58	19	8	2.8	+19
2	+15	+29	+10	+22	+12	60	20	9	2.7	+18
3	+14	+29	+9	+18	+10	62	21	7	2.6	+16
By month	+15	+29	+9.2	+22	+12	60	20	8	2.7	+18
November 2023.										
1	+16	+23	+14	+16	+7	68	23	10	1.3	+17
2	+15	+22	+13	+14	+5	69	23	12	1.3	+15
3	+14	+22.4	+12	+14	+5	70	23	8	1.3	+13
By month	+16	+22.4	+13.4	+14	+5	69	23	10	1.3	+15
December 2023.										
1	+17.2	+17.5	+0.5	+8	+2	75	25	8	1.2	+6
2	+15.6	+17	-9.0	+6	-1	78	26	10	1.0	+4
3	+13.6	+16.9	-2.9	+6	-1	78	26	6	1.1	+3
By month	+15	+17.	-1.3	+6	-1	77	26	8	1.0	+4

		2								
January 2024.										
1	+5	+10	-2	+5	-2	75	25	6	1.1	+4
2	+4	+12	-3	+5	-2	78	26	7	1.0	+5
3	+5	+13	-2	+6	-2	76	25	5	1.2	+3
By month	+4.6	+12.7	-2.8	+5	-2	77	26	6	1.0	+3
February 2024.										
1	+7	+14	-2	+8	-1	76	25	7	1.1	+4
2	+8	+16	-1	+7	-1	77	26	8	1.0	+3
3	+8	+17	-1	+8	-1	78	26	6	1.2	+3
By month	+7.6	+17.1	-0.6	+8	-1	77	26	7	1.0	+3
March 2024.										
1	+13	+22	+2	+12	+4	75	25	8	1.1	+6
2	+15	+27	+4	+13	+5	78	26	10	1.0	+8
3	+16	+39	+5	+13	+5	77	26	7	1.2	+10
By month	+14.7	+27	+4.9	+13	+5	77	26	8.3	1.0	+8
April 2024.										
1	+20	+29	+9	+16	+8	75	25	8	2.1	+13
2	+23	+30	+11	+17	+9	78	26	10	2.3	+15
3	+24	+29	+12	+18	+10	76	25	5	2.5	+17
By month	+22.3	+29.2	+10.5	+17	+9	77	26	7.6	2.3	+15
May 2024.										
1	+26	+30	+12	+20	+12	42	14	10	2.5	+20
2	+28	+34	+14	+21	+13	45	15	12	2.7	+22
3	+30	+36	+16	+22	+14	46	15	10	2.9	+24
By month	+28	+34.7	+15	+21	+13	44	15	10.6	2.7	+22

Table 3

Data on weather indicators for the city of Nukus, Karakalpakstan, in the 2023-2024 academic year.

By Months, Decades	Air temperature /degrees/			Soil temperature /degrees/		Relative humidity /%/		Precipitation amount /mm/	Wind (m/s q m)	Soil temperature at a depth of 10 cm /degrees/
	Average	Max	Min	Max	Min	Average	Min			
Nukus										
September 2023.										
1	+31	+36	+20	+28	+16	40	13	0	4.2	+25

2	+29	+33	+17	+26	+14	43	14	1	4.0	+27
3	+27	+30	+15	+24	+12	45	15	1	3.8	+28
By month	+29	+31.8	+18	+26	+14	41	14	1	4	+26
October 2023.										
1	+20	+29	+11	+20	+12	50	17	1.5	4.3	+17
2	+18	+28	+9	+17	+9	52	17	2.0	4.2	+14
3	+17	+27	+8	+14	+6	54	18	1.2	4.1	+10
By month	+18.8	+27	+11.7	+17	+9	52	17	1.5	4.2	+14
November 2023.										
1	+10	+25	+4	+12	+4	62	21	3	3.2	+8
2	+8	+22	+2	+9	+1	64	21	4	3.0	+5
3	+6	+22	0	+6	-2	66	22	2	2.8	+2
By month	+8	+22.6	+2.9	+9	+1	64	21	3	3	+5
December 2023.										
1	+3	+19	-2	+4	-4	70	23	3	3.1	+3
2	+2	+19	-4	+2	-6	72	24	4	3.0	-2
3	+1	+18	-5	+1	-8	71	23	3	2.9	+1
By month	+2	+19	-3	+2	-6	71	23	3.3	3	+1
January 2024.										
1	-1	+10	-3	+2	-4	73	24	4	3.1	-2
2	-3	+12	-5	0	-6	74	25	5	3.0	-4
3	-4	+10	-6	-1	-8	73	24	2	2.9	-3
By month	-2	+10.7	-4	0	-6	73	24	3.6	3	-3
February 2024.										
1	-2	+19.8	-11.5	+2	-6	68	23	3	5.0	-1
2	+5	+20	-13.4	+4	-4	70	23	4	4.8	+1
3	-4	+20	-13.0	+6	-2	69	23	3	4.9	+3
By month	+2	+20.1	-13.4	+4	-4	69	23	3.3	4.9	+1
March 2024.										
1	+2	+8.7	-7.8	+6	-2	68	23	0	5.0	+1
2	+7	+17.5	-6.8	+10	0	70	23	0	4.8	+4
3	+12	28.8	+1.6	+14	+4	69	23	0	4.9	+7
By month	+8	+28.8	-5	+10	0	69	23	0	4.9	+4
April 2024.										
1	+17	+25	+9	+14	+6	13	4	3	4.0	+9

2	+22	+30	+12	+18	+10	12	4	4	4.1	+13
3	+25	+32	+15	+22	+14	11	4	3	3.9	+19
By month	+21.4	+33.3	+14.5	+18	+10	12	4	3.3	4	+15
May 2024.										
1	+27	+33	+18	+18	+10	36	12	3	4.2	+15
2	+30	+35	+20	+22	+14	34	11	2	4.0	+18
3	+33	+34	+22	+26	+18	32	11	3	3.8	+21
By month	+30.1	+34.1	+22.5	+22	+14	34	11	2.6	4	+18

Classes were held in these climatic conditions. Taking into account climatic conditions, we paid attention to determining the mastery of physical education lessons. According to it, the mastery of the content of physical education lessons by schoolchildren in the first quarter was as follows.

Table 4

Level of mastery of schoolchildren in physical education lessons.

Physical training results of 5th, 6th, 7th, 8th and 9th grade students in the cities of Nukus (Karakalpakstan), Termez, and Fergana										
Classes	30 m. running time		3x10 m. sprint time		2000/3000 m. running time		Writing with folded arms while leaning on the ground (times)		Bending forward from a gymnastic bench without bending the knees (measured from the bottom of the foot down, cm)	
	result	score	result	score	result	score	result	score	result	score
5-class	5.3 sec.	**4**	8.0 sec.	**5**	9.7 minute	**4**	22.5 times	**5**	+9 cm	**5**
6- class	4.8 sec.	**5**	7.6 sec.	**4**	8.9 minute	**5**	25.6 times	**4**	+12 cm	**5**
7- class	4.8 sec.	**5**	7.6 sec.	**4**	9.0 minute	**5**	25.9 times	**4**	+12 cm	**5**
8- class	4.8 sec.	**5**	7.5 sec.	**4**	8.9 minute	**5**	26.5 times	**4**	+12.3 cm	**5**
9- class	4.7 sec.	**4**	7.4 sec.	**5**	11.1 minute	**5**	28.1 times	**4**	+13.9 cm	**5**

Table 3.4 shows the results of 5th, 6th, 7th, 8th and 9th grade students from the experimental group in the cities of Nukus (Karakalpakstan), Termez, and Fergana in performing special test exercises in physical education lessons and the grades given to them.

The results for each grade are shown in the following areas:

1. 30-meter run time (seconds):

o in grade 5 — 5.3 seconds (4 marks),

o in grade 6 — 4.8 seconds (5 marks),

o in grade 7 — 4.8 seconds (5 marks),

o in grade 8 — 4.8 seconds (5 marks),

o in grade 9 — 4.7 seconds (4 marks).

The results show that the speed indicator has improved in senior students, which indicates an increase in their natural development and level of preparation.

2. 3x10 meter shuttle run (assesses reaction and agility):

o in 5th grade — 8.0 seconds (5 marks),

o in 6th grade — 7.6 seconds (4 marks),

o in 7th grade — 7.6 seconds (4 marks),

o in 8th grade — 7.5 seconds, (4 marks),

o in 9th grade — 7.4 seconds (5 marks).

These indicators indicate that the agility and coordination of school-age children improve further with age.

3. 2000/3000 meter run (agility and endurance):

o in grade 5 — 9.7 minutes (4 marks),

o in grade 6 — 8.9 minutes (5 marks),

o in grade 7 — 9.0 minutes (5 marks),

o in grade 8 — 8.9 minutes, (5 marks),

o in grade 9 — 11.1 minutes (5 marks).

In grades 5, 6, 7 and 8, 2000 meters may have been run, and in grade 9, 3000 meters. This difference was taken into account in the assessment. In any case, senior students show better results in terms of endurance.

4. Writing with bent arms while leaning on the floor (strength test, times):

o 5th grade — 22.5 times (5 marks),

o 6th grade — 25.6 times (4 marks),

o 7th grade — 25.9 times (4 marks),

o 8th grade — 26.5 times (4 marks),

o 9th grade — 28.1 times (4 marks).

Although the marks in this exercise are slightly lower, the number of times performed is higher in older students. This indicates that the assessment criteria are applied more strictly to different grades.

5. Bending forward from the gymnastic bench (flexibility):

o 5th grade — +9 cm (5 marks),

o 6th grade — +12 cm (5 marks),

o 7th grade — +12 cm (5 marks),

o 8th grade — +12.3 cm (5 marks),

o 9th grade — +13.9 cm (5 marks).

Flexibility is at a good level in students of all grades. Students of higher grades are slightly superior in flexibility.

As can be seen from the table, most physical indicators improve as students grow older. In particular, there is a positive increase in running, endurance and flexibility. However, due to the relative rigidity of the assessment criteria depending on the grade, in some cases, despite high results, lower marks were given. This indicates that students are assessed based on the dynamics of their development and norms appropriate to their age.

Table 5

Level of mastery of schoolchildren in physical education lessons.

Physical training results of 5th, 6th, 7th, 8th and 9th grade students in the cities of Nukus (Karakalpakstan), Termez, and Fergana										
Classes	30 m. running time		3x10 m. sprint time		2000/3000 m. running time		Writing with folded arms while leaning on the ground (times)		Bending forward from a gymnastic bench without bending the knees (measured from the bottom of the foot down, cm)	
	result	score	result	score	result	score	result	score	result	score
5-class	5.0 sec.	**5**	8.8 sec.	**4**	10.2 minute	**4**	15.3 times	**4**	+5 cm	**4**

6- class	5.1 sec.	**4**	7.2 sec.	**5**	11.1 minute	**3**	24.2 times	**4**	+6.2 cm	**4**
7- class	5.2 sec.	**4**	8.2 sec.	**3**	9.4 minute	**4**	28.5 times	**4**	+5.1 cm	**4**
8- class	4.7 sec.	**5**	7.8 sec.	**4**	8.1 minute	**5**	29.4 times	**4**	+5.2 cm	**3**
9- class	4.5 sec.	**4**	8.0 sec.	**3**	14.3 minute	**4**	45.2 times	**5**	+10.6 cm	**4**

Table 3.5 presents the physical fitness indicators and assessments of students in grades 5–9 in the regions of Termez, Fergana, and Karakalpakstan (Nukus city). Based on the table, the dynamics of the development of students at different ages, their strength, speed, endurance, agility, and flexibility potential were assessed.

1. Speed (30-meter run)

• From grade 5 to grade 9, the speed indicators of students gradually improve:

• 5.5 sec. → 5.3 sec. → 5.2 sec. → 5.3 sec. → 5.0 sec.

• According to the assessment criteria, the average grades are between 3–4,

• Only grade 7 recorded a grade of 4.

This indicates that the speed potential develops with age.

2. Agility (3×10-meter shuttle run)

• In all grades, the results of this exercise ranged from 8.8 sec. to 8.0 sec.

• The grades were between 3–4 and were stable.

This indicates the need for a more individual approach to developing agility.

3. Endurance (2000/3000 meter run)

• The indicators show that the students improve as they get older: 11.5 min. (5-6th grade) → 11.0–10.6 min. (7–8th grade) → 13.3 min. (9th grade)

In the 9th grade, the running distance was probably 3000 meters, which, despite the high time, was rated 4.

4. Handwriting (strength)

• Results: increased from 15.3 times (5th grade) → 23.2 times (9th grade).

• The scores remain in the range of 3–4, which indicates that the assessment criteria are becoming stricter depending on the grade.

5. Flexibility (leaning forward from a gymnastic bench)

• Flexibility indicators are almost stable: from +5 cm to +7.4 cm

• Scores: at the level of 3–4.

Flexibility is one of the innate and developed physical qualities of the body, and its overall level is good.

It is noticeable that physical development indicators among students in grades 5–9 gradually improve biologically and functionally with age.

Among the indicators, endurance and flexibility remain at a relatively high level, while stability is observed in agility and strength exercises.

Scores are in the range of 3–4, which means that the physical fitness of students is at an average level.

Climate change is currently a global problem that has a significant impact on nature, the economy, and people's lives. Although the consequences may vary in different regions, their overall scale is of serious concern to scientists, ecologists, and politicians.

This is causing the average temperature on planet Earth to gradually increase. This is leading to hotter summers, milder winters, and more frequent weather extremes: intense heat, droughts, floods, storms, and snowfalls. Such events are becoming increasingly unpredictable and cause various man-made conditions.

As a result, students become dehydrated and fall into a state of weakness.

This leads to decreased learning, increased risk of heatstroke, and decreased healthy lifestyles. Therefore, it would be appropriate to schedule physical education classes in the first shift with young students for 1-2 hours in the morning, and in the second shift for the last hours.

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