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## The evolution of the physical effort curve during the physical education and sports lesson

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### Abstract

*Introduction:* In physical and sports education, the effort dosing is essential for achieving the goals and is managed by altering the effort parameters and correlating these with a certain type of rest, respecting the physical norms of the body. According to a study, analyzing and comparison of "The Gauss curve" during a physical education and sport lesson, the expected rising of the effort curve was denied during its first 3 stages. Especially between stage 2 (Preparation of the body for effort) and stage 3 (Selective influence of the locomotive apparatus) there is a decrease of the heart rate. During the sports lessons, we recorded for 10 hours the heart rate of 10 children from 2 different classes of the same grade, 5-A and 5-B, creating one control group (of 5 boys) and one experimental group (5 boys). For the experimental group we recorded for 10 different classes, interchanging stages 2 with 3, more exactly, the stage "Selective influence of the locomotive apparatus" was done before the stage "Preparation of the body for effort", and for the control group we also recorded for 10 different classes, but they performed the normal sports lesson, following the stages in chronological order. *Objective of the study:* The objective of this research was to discover/identify if the effort curve follows an ascendant trajectory during the first 3 stages and a descendant curve during the last 3, by analyzing the heart rate for each stage during the physical education and sports lesson. *Material and methods:* The data was collected using 5 - Polar M400 watches and 5 - H7 chest bands, during sport lessons inside the School "Aghiresu Fabricii" from Cluj-Napoca. After the recorded data of the heart rates were analyzed, we observed the differences between the classic sport lesson and the one with the stages 2 and 3 reversed, for the 5<sup>th</sup> grade subjects. *Results:* By comparing the data obtained from the recordings, it was found that there are some differences between the classical physical education lesson and that in which interventions were made in the second and third stages, as a result of the change in heart rate values in the investigated subjects. *Conclusion:* Analyzing the two groups in which we had different approaches in the physical education and sports lesson, it is denied that in the classical lesson we have a curve of ascending effort in the first stages. As a result of the reversal of the two-to-three stages, an ascending curve – the Gaussian Curve – is achieved through which an optimal adaptation to effort is made in the fundamental part of the physical education and sports lesson.

**Key words:** effort curve, heart rate, physical education.

### Rezumat

*Introducere:* În lecția de educația fizică și sport, dozarea efortului este esențială pentru realizarea obiectivelor și se realizează prin modificarea parametrilor efortului și corelarea cu un anumit tip de pauză, respectând legile fiziologice ale organismului. Studiind, analizând și comparând evoluția "Curbei lui Gauss" în lecția de educație fizică și sport, s-a înfirmat faptul că aceasta crește în primele 3 verigi ale ei, mai exact între veriga 2 (Pregătirea organismului pentru efort) și 3 (Influențarea selectivă a aparatului locomotor) existând o descreștere a frecvenței cardiace. Am înregistrat timp de 10 ore frecvența cardiacă a 10 copii din două clase diferite, a 5-a A și a 5-a B, astfel realizând o grupă control (5 băieți) și o altă grupă experiment (5 băieți). Pentru grupa experiment s-au înregistrat 10 ore, inversând verigile 2 cu 3, mai exact "Influențarea selectivă a aparatului locomotor" s-a realizat înaintea verigii "Pregătirii organismului

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pentru efort”, iar grupa control a susținut lecția clasică, urmând în ordine cronologică toate verigile lecției de educație fizică și sport în decursul a 10 ore. *Obiectivul cercetării:* Obiectivul cercetării a fost de a descoperi/identifica dacă într-adevăr curba efortului urmează o traiectorie ascendentă în primele 3 verigi și o curbă descendentă pe ultimele 3, analizând frecvența cardiacă pentru fiecare verigă a lecției de educație fizică și sport. *Material și metode:* Datele au fost colectate cu ajutorul a 5 ceasuri Polar M400 și 5 benzi toracale H7 pe întreaga durată a lecțiilor de educație fizică din cadrul Școlii "Aghireșu Fabricii" din județul Cluj – Napoca. După ce s-au comparat datele înregistrate, am avut posibilitatea de a observa diferențele dintre lecția clasică de educație fizică și cea în care s-au schimbat verigile 2 cu 3, analizând valorile frecvenței cardiace a subiecților de clasa a 5a. *Rezultate:* Comparând datele obținute în urma înregistrărilor, s-a constatat că există anumite diferențe între lecția clasică de educație fizică și cea în care s-au efectuat intervenții în cadrul verigilor doi și trei, ca urmare a modificării valorilor frecvenței cardiace la subiecții cercetați. *Concluzie:* Analizând cele două grupe, în care am avut abordări diferite în cadrul orei de educație fizică și sport, se infirmă faptul că în cadrul lecției clasice avem o curbă a efortului ascendentă în primele trei verigi. Ca urmare a inversării verigilor doi cu trei, se obține o curbă ascendentă – Curba lui Gauss – prin care se realizează o adaptare optimă pentru efort în partea fundamentală a lecției de educație fizică și sport.

**Cuvinte cheie:** *curba efortului, frecvența cardiacă, educație fizică.*

## Introduction

During the physical education and sports lesson, the effort dosing is essential for achieving the goals and is managed by altering the parameters of effort and correlating them with a certain type of rest, respecting the physiological laws of the body.

The effort in physical education and sports, as well as other human activities, is determined by the objectives specific to each theme addressed during the lesson, which also leads to a differentiation of the three classical parameters of effort: volume, intensity and complexity. Therefore, the process of planning the effort is extremely difficult for specialists.

The dynamic effort in a physical education and sports lesson, confused with density (being something "truth in confusion!"), is nothing more than its "curve", its "trajectory" in graphic representation according to the succession of structural sequences.

Studying, analyzing, and comparing the evolution of the "Gauss Curve" during the physical education and sports lesson, it was denied that "it has a steadily ascending curve in its first three sequences", more precisely between the second and third sequence with a decrease in heart rate [1, 2].

## Objective of the study

The objective of this research was to discover/identify if the effort curve is following an ascendant trajectory during the first 3 stages and a descendant trajectory during the last 3, by analyzing the heart rate for each stage during the physical education and sports lesson.

## Materials and Methods

For this study we used 5 - Polar M400 watches (Figure 1) and 5 - H7 chest bands with Bluetooth (Figure 2) to monitor the heart rate of the students [3, 4].



**Figure 1.** Polar M400 watch (gadgetway)



**Figure 2.** H7 chest band (wshop)

The study was carried out at the High School "Aghireșu Fabricii" in Cluj-Napoca, with 2 classes from 5<sup>th</sup> grade, 10 students, during the 1<sup>st</sup> semester of the year 2016-2017, and comprising 10 hours for each class, starting on the 20<sup>th</sup> of September 2016 (first recording) and finishing on the 20<sup>th</sup> of October 2016 (last recording).

**Table I.** Anthropometric measurements for the control group

Subject	Name Surname	Age	Weight (kg)	Height (cm)
1	Z. C.	11	44	150
2	O. D.	11	43	146
3	C. L.	11	42	146
4	L. C.	11	42,5	148
5	G. S	11	40	145

**Table II.** Anthropometric measurements for the experimental group

Subject number	Name Surname	Age	Weight (kg)	Height (cm)
1	G. E.	11	45	150
2	C. M.	11	42,5	145
3	G. L.	11	42,5	148
4	T. P.	11	41	146
5	H. L.	11	43	148

The 10 lessons in which the students were followed and observed, were part of two learning units “Developing the movement quality: Speed” and “Learning, Enhancing, Improving and Verifying the movement Skills in Basketball” with the following topics and objectives:

topic **1** – Date: 20.09.2016, topic: Speed, Initial evaluation for speed running on 30 and 50 meters; Basketball, learning the catching and passing the basketball;

topic **2** – Date: 22.09.2016, topic: Speed, Speed development on auditory stimuli; Basketball, learning the basic attack / defense position and field trips;

topic **3** – Date: 27.09.2016, topic: Speed, Speed development on different auditory, visual stimuli; Basketball, Strengthening catching and passing the Basketball;

topic **4** – Date: 29.09.2016, topic: Speed, Lower start and launched start learning; Basketball, learning the passing with two hands on the chest and with the ground;

topic **5** - Date: 04.10.2016, topic: Speed, Reinforce the lower start and launched start, learning the launched speed step; Basketball, Reinforce the passing and learning the simple dribbling;

topic **6** - Date: 06.10.2016, topic: Speed, Reinforce the launched speed step on various distances; Basketball, Reinforce the dribbling and learning to throw the ball at the basket;

topic **7** - Date: 11/10/2016, topic: Speed, Speed development on relay, contests; Basketball, learning to stop in time;

topic **8** - Date: 13.10.2016, topic: Speed, Dynamic games for speed development; Basketball, basketball training;

topic **9** - Date: 18.10.2016, topic: Speed, Development of the speed reaction, speed execution, and movement as a contest; Basketball, reinforcement of throwing the ball at the basket on-the-spot, running and dribbling;

topic **10** - Date: 20.10.2016, topic: Speed, Speed test 30/50 meters – balanced score, Basketball, bilateral game on one panel.

**Stage 7** (Calming the body after the effort) lasted about 3-4 minutes and had the following objectives: return of the functional capacity to normal parameters, decreasing the level of effort. These objectives were achieved through breathing exercises, stretching and light running.

**Stage 8** (Conclusions and Recommendations) was done in 2-3 minutes with the following objectives: forming the evaluation and self-evaluation capacity and drawing a conclusion for the lesson.

**Results**

For the control group (classical physical education lesson), the following mean heart rate values were recorded, so we observed an effort curve that does not follow an ascending trajectory in the first three stages, and the last part of the effort dynamic, on the last three stages is slightly descending (Figure 3). The heart rate was recorded at the end of each stage.

**Table III.** Average heart rate of the control group at the end of each stage

Control group								
Name Surname	Initial heart rate	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 7	Stage 8
Z. C.	97	100	154	128	186	188	135	131
O. D.	95	100	157	130	178	188	141	134
C. L.	101	107	166	133	187	190	143	135
L. C.	100	105	161	137	180	186	137	130
G. S	103	105	170	137	186	184	134	129
<b>Average</b>	<b>99</b>	<b>103</b>	<b>162</b>	<b>133</b>	<b>183</b>	<b>187</b>	<b>138</b>	<b>132</b>

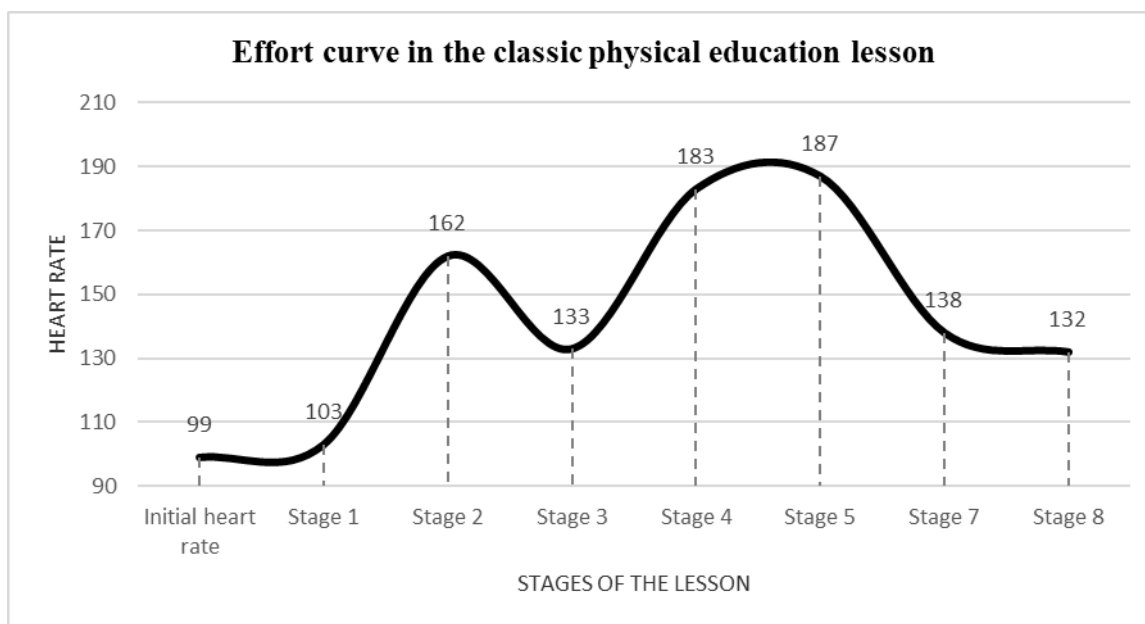


Figure 3. Graphic representation of the heart rate average for the control group

Table IV. Average heart rate of the experimental group at the end of each stage

Experimental group								
Name Surname	Initial heart rate	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 7	Stage 8
G. E.	97	99	125	166	186	190	130	126
C. M.	94	99	130	171	190	188	134	130
G. L.	95	101	127	169	187	191	145	136
T. P.	101	105	128	173	170	189	135	132
H. L.	100	102	132	175	190	188	134	130
<b>Average</b>	<b>97</b>	<b>101</b>	<b>128</b>	<b>171</b>	<b>185</b>	<b>189</b>	<b>136</b>	<b>131</b>

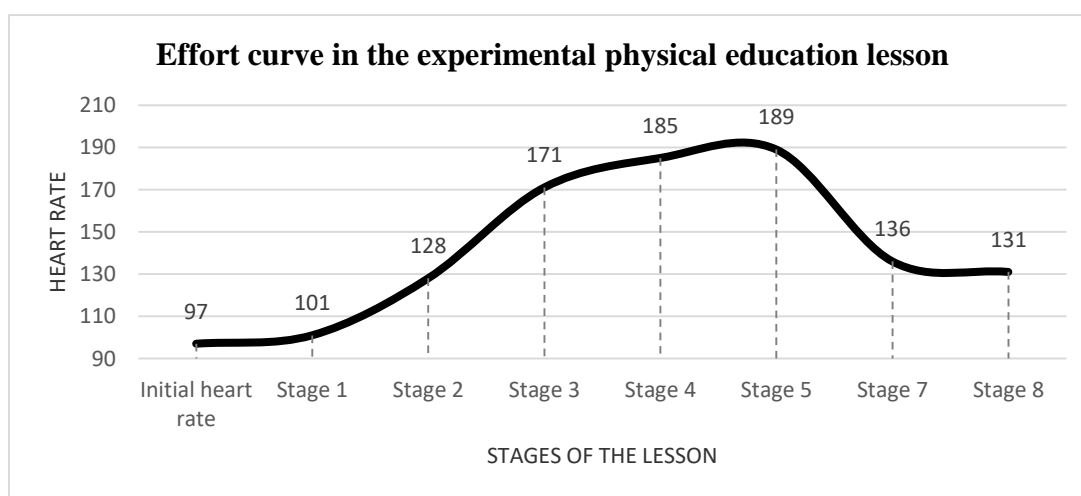


Figure 4. Graphic representation of the heart rate average for the experimental group

For the experimental group (the lesson in which the order for stages 2 and 3 was interchanged) the average heart rate shows an ascendant curve during the first 3 stages, and a significant decrease on the last part of the lesson, closer to normal values (Figure 4).

### Conclusion

Comparing these 2 classes, in which we had 2 different approaches of how the lessons were performed, we conclude the fact that in the classical physical training lesson we do not have an ascendant effort curve during the first 3 stages. After we interchanged stages 2 and 3, we obtained an ascendant curve (Gauss curve) and we can offer to students a better preparation for effort, before the fundamental part of the training lesson.

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