

# The importance of systematic planning and implementation of physical education in the first three years of elementary school

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## *Abstract*

*Introduction:* The purpose of this paper is to analyze the importance of systematic planning and implementation of physical education in the first three years of primary school for the development of endurance. The importance of physical education “in person” has already been proven in Slovenia by the fact that the general physical performance of students decreases when they return to school after a long period of distance learning. In this paper we analyze the importance of systematic planning and implementation of physical education for the development of aerobic power. *Methods:* In this research sample, we included two elementary schools that are located in a similar geographic environment (lake, mountains, proximity to forests and meadows, proximity and variety of safe routes, etc.) but have different ways of planning and implementing physical education. The first is the Slovenian elementary school, where 105 physical education lessons and 5 sports days are systematically planned and included in the annual curriculum each year. The second is the Austrian elementary school, where there are 105 physical education lessons in the first and second grades and 70 physical education lessons in the third grade, however they have no sports days in any class and there is a loose annual plan for physical education, without preparation of individual physical education lessons. The sample consists only of healthy students from the two elementary schools at the end of the first three years (i.e. 66 third grade students, 33 from Slovenia and 33 from Austria). The sample of variables represents a “beep test” for measuring aerobic power (Leger and Lampert, 1982). All participating students volunteered for the test. The procedure and method of motivation was the same for all. Students had to run a distance of 20 meters as many times as possible, taking into account the running pace, which increased by 0.5 km/h every minute at an initial speed of 8.5 km/h. Results were recorded as the sum of all partial distances the student could still run

at the forced pace. *Results:* Slovenian students completed an average of 33.4 (SD = 12.9) stages of the test, while Austrian students completed an average of 26.7 (SD = 11.8) stages. Analysis of the results shows that Slovenian students completed on average almost 7 more stages than Austrian students. Boys and girls did not differ among either Slovenian or Austrian students. Because of the abnormally distributed data, we used the alternative nonparametric Mann Whitney U test to detect statistically significant differences between students. Slovenian students performed statistically significantly better than Austrian students ( $U = 373.0$ ,  $p = 0.028$ ). *Discussion and conclusions:* Based on the results, we conclude that systematic planning of the subject of physical education, which requires in-depth and systematic planning by the teacher, contributes significantly to the development of aerobic power. Aerobic power is an indicator of endurance, which is one of the most important factors for health. Despite the many indirect influences on the development of aerobic power, we believe that the teacher plays a more important role in its development than he may realize.

*Keywords:* endurance, aerobic power, conception and implementation, first triad

## Introduction

Endurance is a functional ability of a person that enables him or her to perform an activity for a long period of time without having to interrupt it due to fatigue (Škof, 2010; Retar, 2019). Endurance is usually divided into aerobic and anaerobic based on the predominant way the ATP molecule is obtained (Patel, 2017). Aerobic or cardiovascular endurance is increased in any activity that is performed over a long period of time, continuously, and in a cyclic loading pattern, as is typical for swimming, running, cycling, cross-country skiing, etc. (Bishop, 2010). The main limiting factor of aerobic endurance is maximal oxygen uptake (Ušaj, 2014), which is measured in laboratories using a special protocol and while wearing a special mask that allows calculation of oxygen consumption based on gas exchange (Insel, Walton, and Fahey, 2017).

Measuring aerobic endurance in the laboratory is obviously not possible in schools because of the large number of students. Therefore, a series of tests were developed and the results were compared with the results of the laboratory tests. The compared results indicated which tests should be performed with repetitive movements and in what manner in a natural environment to obtain the most comparable results. It turned out (Lang et al., 2016) that the “Beep Test” is the most reliable and widely used test for measuring aerobic performance in recent years, as it is performed in more than 50 countries and is also part of the EUROFIT measurement battery. Neville et al. (2021) state that the “Beep Test” is the so-called gold standard for measuring aerobic performance in schools. The same authors emphasize the ease of use in schools, the importance of performing the test with several students at the same time, the good control of performance, the affordability, the importance of proven compara-

bility with laboratory results, and the importance of comparison between different age groups, schools, countries, etc.

The “Beep Test” can be found under various names: Incremental Run, Multi-stage Fitness Test, Beep Test, Pacer Test, Leger Test, and 20-m Shuttle Run Test. They are exactly the same execution, namely that the participant runs a distance of 20 m, while the pace of the run is determined by a sound signal. The frequency of the sound signal increases by half a kilometer per hour every minute, starting at 8.5 km/h. If a person is unable to cross the 20-meter line after two consecutive tones, the test is over for them and the last distance traveled is recorded (Ruiz et al., 2010).

We use the test to determine the level of endurance or individual aerobic capacity of each student, which is the starting point for preparing physical education classes with the goal of developing endurance. Aerobic endurance is one of the functional abilities of a person that is positively related to the cognitive performance of an individual (Howie et al., 2015), so it is very important to develop it systematically in schools. There is a trend of decreasing endurance in schools (Starč et al., 2020), so experts are already warning of the consequences not only for health but also for the decline of cognitive functions.

At schools, there are various options for endurance training (running, cycling, in-line skating, swimming, cross-country skiing, hiking, etc.). Endurance training usually takes place outdoors, so geographic location (distance or proximity to lakes, mountains, forests, trails, etc.) is an important external factor in implementation. The next important factor is the curriculum and its implementation, and this is the external factor we focus on in this study. We want to investigate the importance of the implementation of Physical Education, the annual curriculum, structured preparation and other forms of implementation of the Physical Education (school in nature and sports days) in schools for aerobic performance in the first three years of primary school.

## Methods

### *A sample of participants*

The study sample includes two elementary schools that are located in similar geographic settings (lake, mountains, proximity to forests and meadows, proximity and variety of safe trails, etc.) but use different methods for planning and implementing physical education as a subject. The first is a Slovenian elementary school where 105 hours of physical education and 5 sports days are systematically planned each year and included in the annual curriculum; the second is an Austrian elementary school where 105 hours of physical education are planned in the first and second grades and 70 hours of physical education are planned in the third grade, and no sports days are planned in any grade, and again there is a loose annual plan for physical education without preparation of individual sports lessons. Only healthy students from both elementary

schools were included in the further study at the end of the first three years (i.e., 66 third grade students, 33 from Slovenia and 33 from Austria).

### *A sample of variables*

We included the “beep test” (Leger and Lampert, 1982) in the sample of variables. The “beep test” is a standardized test for measuring aerobic power. From the partial values obtained, the maximum oxygen uptake can be determined in the tables for each age.

### *The organization and process of data collection*

All participating students took the test voluntarily. The administration of the test and the method of motivation were the same for all students. We administered the test at approximately the same time (morning time, April 2022). Endurance is influenced by many factors that we wanted to mitigate as much as possible (daily well-being, prolonged illness, individual participation in endurance activities during leisure time, etc.). Only healthy students were included in the sample. By increasing the sample size, we aimed to reduce individual influences on the outcome. Students were required to run a distance of 20 meters as many times as possible, taking into account the running pace, which increased by 0.5 km/h every minute at an initial speed of 8.5 km/h. Results were recorded as the sum of all partial distances the student could still cover at the given speed.

### *Methods of data processing*

The data obtained from the “beep test” were processed using the statistical program SPSS 21 (Statistical Package for The Social Science). For the comparison between Slovenian and Austrian students, due to the abnormally distributed data, the alternative nonparametric Mann Whitney U test was used to detect statistically significant differences between students. Statistical significance was tested at the 5 percent risk level.

## **Results**

The results of our investigation are presented in a table and a figure. In figure 1 we present a comparison between Slovenian and Austrian students in terms of the average sublevel achieved, while the table shows whether the perceived differences are statistically significant.

Figure 1 shows that Austrian students passed an average of 26.7 sublevels of the beep test, while Slovenian students passed 33.4 sublevels. Using the Kolmogorov-Smirnov test, we found that the distribution curves of the results for both the Austrian and Slovenian students did not conform to the normal distribution. Therefore, we used nonparametric tests below to measure the differences between the groups of students.

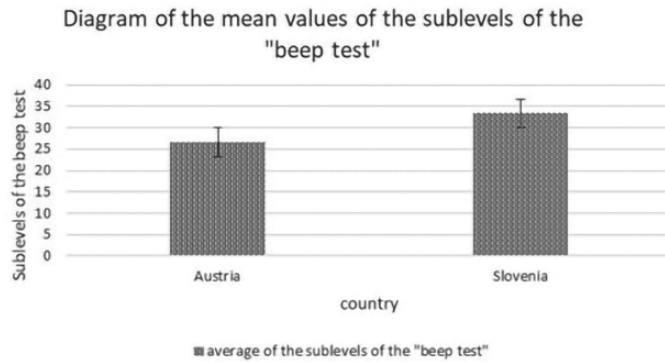


Figure 1: Diagram of differences between Slovenian and Austrian students in the sublevels of the beep test. (Source: Author).

Table 1: Ranks and Test Statistics

Beep test	Beep test	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Sig.
Sublevels of beep test	Austria	33	28,3	934,0	373,0	934,0	0,028*
	Slovenia	33	38,7	1277,0			
	Total	66					

N – number of participants, \*  $p < 0.05$

Table 1 shows that Slovenian students differ statistically significantly in the number of sublevels of the beep test passed ( $U = 373$ ,  $p = 0.028$ ). The analysis of the results of the comparison schools shows statistically significant differences in the aerobic performance test. In the following we will try to find the reasons for this and make some suggestions.

## Discussion

We have based the study on three foundations, first, the importance of developing endurance in the first triad of elementary school, second, the importance of good curricular starting points (core competencies and a concept-based approach), and third, the importance of writing precise and structured lesson plan documents.

There are many factors that influence endurance, the most common of which include obesity (Matejek et al., 2014), one's activity level, heredity, biological basis, and daily form (Škof, 2016; Ušaj, 2003). In addition to physical performance, the effects of endurance affect various cognitive functions that are indispensable in the educational system and consequently influence student performance. Aerobic exercise improves blood flow to the brain and increases the concentration of the neurotrophin BDNF for neuron growth (Pencea et al., 2001). Neural networks are also associated with solving other cognitive problems (Singh et al., 2019), which consequently means that students learn new

cognitive concepts more easily and quickly. Starc et al. (2020) note that the decline in student endurance after returning to school is due to various interventions during an outbreak of coronavirus disease, suggesting a resulting decline in cognitive performance and consequently academic success. Resilience is thus an important functional skill, and it makes sense to include it in the general curriculum of educational systems.

A comparison of educational systems (Gracar, 2015) and especially of curricular starting points between Austria and Slovenia shows that Austrian starting points are more comprehensive, less specific and more general. In particular, the analysis of lesson plan documents (Kovač et al., 2011; Jahresplanung, 2021) of annual training preparations and preparations for individual lessons shows that Slovenian annual training preparations for the subject of physical education are more structured, more weekly hours are devoted to them, and they have additionally defined sports days and school-based character.

The results of our study show that it makes sense to structure curricula better and give teachers fewer choices. Compared to the Austrian children, the Slovenian children passed almost 7 more sublevels in the placement test (Figure 1). Because of the scatter of the data, we used the nonparametric Mann Whitney U test, which showed that the differences were statistically significant (Table 1). We adjusted for age and external conditions, selected schools that were as similar in size as possible, and attempted to limit any factors that would make it financially or organizationally impossible to conduct the exercise.

### Conclusions

We found differences between the groups. We believe that the openness and less structured nature of the curriculum allows the teacher to work more flexibly for the students and him/herself. On the other hand, we find that greater structure can mean more reliable and consistent delivery of endurance activities.

The limitations of the study lie primarily in the number of students selected and, relatedly, teachers, who may be an important factor in the frequency and intensity of instruction. By determining 24-hour intensity, we would obtain more detailed data on extracurricular activities than by subjectively assessing the frequency and intensity of instruction. By increasing the sample size of comparable schools from several countries with different curriculum structure and openness, with direct measurement of additional physical activity, and with different mechanisms for evaluating teachers' work, our conclusions would be more reliable.

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