Climbing literacy project for children and youth: a utility analysis

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Abstract:

The ability to maintain and control the balance is the basis for the design and construction of more complex motor skills in the context of sports performance and thus sports can influence the control of static balance in physical education at school. We argue that climbing can be one of such sports. The paper analyzes the project of a climbing center created as a co-creation initiative, thanks to which pupils have the opportunity to attend a climbing wall during physical education classes for free. Moreover, on this example the applicability of cost-utility analysis method is verified to test the effectiveness and usefulness (utility) of such education, with regard to the spending of public finances by local self-governments. Cost-utility analysis is an internationally recognized method in health services, this paper demonstrates its use in the field of sports, which, similarly to healthcare, belongs to public services. The method is slightly modified and with further modifications it can be used in any country. Research sample consists of 251 pupils and 16 teachers in Slovakia, from primary and secondary schools in the district of Žilina, Slovakia. Pupils are interested in this form of educational process, which has a positive effect on the physical and mental aspects of their personality development. The article also proves the applicability of the cost-utility analysis method for the evaluation of effectiveness in the field of sport, although it is primarily a method used in health care. The paper demonstrates positive effect on the physical and mental side of the development of pupils as well as the applicability of the cost-utility analysis method for evaluating the effectiveness of sport.

Key Words: Sport climbing, Physical performance, Physical education, Cost Utility Analysis

Introduction

Physical activities and sports, including climbing, have been used to eliminate fear when moving at height, to acquire certain motor abilities and skills, to increase dexterity and at the same time as a means of mental development, such as human victory over gravity or increase courage and confidence. Sport climbing as an Olympic sport is gaining in popularity, even in smaller regions and towns. Sport climbing has transformed from within the group of mountaineering sports. It is usually done on artificial climbing walls, thanks to which it has been developing en masse in recent years. Its attractiveness lies in overcoming the personal challenge, overcoming the objective risk, the complexity of physical development, especially for recreational climbers (Sheel, 2004). Climbing walls are becoming part of various sports multiplexes, but can also be found in independent commercial sports grounds which can offer an attractive environment, sports experiences, services, as well as various educational activities (Kompan & Babiar, 2011). It is the perception of the power of the experience and challenge that is an excellent marketing tool that is currently attracting the attention of the general public and is reflected in the new structure of services in tourism (Neuhof et al., 2011).

The first climbing walls were built in military training at the turn of the 18th and 19th centuries. Another example was a wall built by climbers in Paris in the early 1940s. In the 1950s and 60s, other walls began to appear, especially for pedagogical purposes, which were built in gyms by teachers together with students (Baláš, 2009). Scientific studies began to emerge (e.g. Mermier, 2000; Nick, et al. 2009, 2016; Forster, 2009 and others) that addressed climbing issues, but the interest mainly concerned adult climbers. Only in recent years have studies on climbing activities with children emerged (e.g., Watts et al., 2003; Ceciliani, 2008; Morrison & Schöffl, 2007; Aykora, 2019). The authors agree that it is best to start climbing with children in hobby groups from the beginning of school attendance (from about 6 years of age). A great contribution to the benefits of challenge activities are the shared experiences of children and teachers. Climbing or overcoming obstacles using rope obstacles is part of teambuilding activities (Blahutková et al., 2013). Altavilla et al. (2014) state, the ability to maintain and control the balance is the basis for the design and construction of more complex motor skills in the context of sports performance and thus sports can influence the control of static balance in physical education at school. We argue that climbing can be one of such sports.

The motivation for the elaboration of the article was to analyze a unique project of a climbing center, which offers climbing for primary and secondary schools, free of charge as part of physical and sports education. In this paper, we also verify the applicability of the Cost Utility Analysis (CUA) method, which makes the article interesting for international readership, as it is an innovative approach to evaluating efficiency since DEA is commonly used (e.g., Barros et al., 2010). CUA is an internationally recognized method in health services, this paper demonstrates its use in the field of sports, which, similarly to healthcare, belongs to public services. The method is slightly modified and with further modifications it can be used in any country.

Theoretical framework

The structure of sport climbing performance was also discussed by Goddard and Neumann (1993), Magiera et al. (2013), Hörst (2009). According to the authors, climbing performance is an expression of the whole person and must be considered as a whole of many different conditions and abilities. Climbing is developing comprehensively in most European countries, and in some schools, we can also find climbing in physical education curricula (Ceciliani et al., 2008). Skills that are developed through climbing are listed in Table 1, these skills were also used to create the questionnaire (see Research Design).

Table 1. Abilities and aspects of climbing in human development

Ability	Example	Authors
Fitness (strength, speed, endurance, flexibility)	Grip - grip strength, arm strength endurance, finger flexor strength - maximum finger flexor strength, forearm flexor strength, arm and shoulder girdle flexors, dynamic overlap, local strength endurance - especially forearms, anaerobic endurance, ability to perform movement in maximum articular range, flexibility in hip and ankle joints	Grant (1996), Baláš et al. (2012), Nick, et al. (2009), Hörst, (2009), Goddard & Neumann, (1993), Wall et al. (2004)
Equilibrium	When moving from one hold to another, the climber must quickly identify and adjust their body proportions and center of gravity to the new hold.	Cheung (2011), Grant (1996), Sanchez et al. (2019)
Kinesthetic-differentiation abilities	Movement consists of high precision, accuracy, harmony and the economics of the phases of movement as a whole. These movements are often performed in a time deficit, for example in speed climbing.	Watts (2003), Baláš et al. (2009, 2012), Kraft (2014), Legreneur et al. (2019)
Reaction abilities	When climbing, the sharpness of feelings (visual, auditory, kinesthetic), the perception of space and also the specific perception of the sensitivity of the height and depth of the terrain are highly applied. This ability is important when a climber makes a quick decision on how to grab a hold or when deciding in which direction to climb.	Kraft (2014), Mermier et al (2000), Baláš et al. (2009)
Spatial - orientation abilities	When climbing, the climber must be able to orient themselves in the directions of climbing, because they do not always go upwards. They must also be able to orient themselves in choosing the best possible holds and footholds when proceeding on a rock wall in which conditions and situations are constantly changing.	Long (2007), Sheel (2004)
Forming human personality	Responsibility for others, independence, overcoming (oneself) one's own limits, personal growth, self-confidence, decision-making, moral qualities.	Blahutková, et al. (2013), Brymer & Mackenzie (2017)
Psychological aspects	Coping with unpleasant feelings, overcoming fear, pre-start states, strengthening self-confidence, physical performance, cooperation.	Brymer & Mackenzie (2017), Llewellyn (2008)
Health aspects	Climbing activities lead to a comprehensive development of the locomotor system. In particular, strength skills and endurance of the muscles of the forearm, fingers and upper limbs are developed. Flexibility and balance are improved. The climber should be able to regulate their movements as needed. Regular climbing improves performance and technique.	Steimer & Weissert (2007), Heitkamp et al. (2005), Long (2007)

Source: own, based on authors

From the mentioned benefits of climbing, it is clear that this sport has its justification in schools and with regard to its therapeutic and health effects, we have chosen it for the application of the CUA method. The most important principles of education are building trust in the safety equipment of fellow climbers, as well as building trust in oneself and thus overcoming one's own boundaries and cultivating mutual cooperation in a group. Climbing is developing comprehensively in most European countries, including in physical education curricula (Kremnický et al., 2010).

The construction of new climbing walls has been increasing in recent years and climbing has become more attractive for both children and adults. An increase in the number of members of the Slovak Mountaineering Union JAMES is documented by the following statistics (Fig. 1):

Figure 1 Number of members in the Slovak Mountaineering Union JAMES
Source: Slovak Mountaineering Union JAMES

As of 31 December 2020, the union has 7,829 registered members, and their structure is as follows:

- 5,733 adults,
- 124 youth,
- 1075 children,
- 897 senior citizens.

Climbing conceived in this way has great preconditions to become a part of the so-called co-creation. Co-creation means providing public services in an innovative way, with the participation of governments, companies, citizens and/or non-governmental organizations (NGOs). This cooperation of various stakeholders was mapped within Europe in the international research project LIPSE (Learning from Innovations in Public Sector Environment), which defined co-creation as the involvement of citizens/NGOs at least in the initiative and/or design of public services, with the aim to create public value. (Voorberg et al., 2015). On behalf of Slovakia, a team led by Nemec et al. (2015), was involved in the LIPSE research, who stated that the role of local self-government in co-creation in Slovakia was rather limited. The co-creation mostly happens in the fields of environment, public spaces and urbanism, social services and healthcare (Nemec et al., 2015).

Material & methods

The aim of the paper is to analyze and evaluate the climbing center project, based on which pupils had the opportunity to visit a climbing wall during physical education classes and in this example to verify the applicability of the CUA method to test the effectiveness and usefulness of the service. Other methods used to collect the data were a survey and a structured interview.

The selected sample of the survey set for the processing of the work were primary and secondary schools in the district of Žilina. Specifically, these were schools located near the La Skala climbing center, 18 secondary and 9 primary schools were addressed. Due to the situation associated with COVID-19, only 5 secondary and 3 primary schools were willing to participate in the survey (limited teaching and contact for pupils and teachers). A total of 16 physical education and sports teachers and 251 pupils participated in the survey. The specific schools involved in the survey are in Table 2.

The survey took the form of a survey of teachers and pupils, which we compiled according to the factors / abilities listed in Table 1. The survey was supplemented by information obtained from interviews with representatives of the La Skala climbing center which offers free climbing for those schools.

Table 2 List of schools involved in the survey

Schools	Boys	Girls	Male teachers	Female teachers
Primary School, Vendelína Javorku 32	10	30	3	0
Grammar School, Hlinská 29	8	6	0	1
Secondary Medical School in Žilina	0	17	0	1
Bilingual Grammar School, T. Ružičku 3	17	92	1	2
Primary School, Limbová 30	26	23	1	1
Grammar School, Varšavská 1	10	12	2	1
Primary and kindergarten Brodno	0	0	0	1
Secondary Sport School	0	0	1	1
TOTAL	71	180	8	8

Source: own

The obtained data formed the input data for the analysis of usefulness by the CUA method, which compares the costs of different procedures with their outcomes measured in "utility based" units - that is, units that relate to a person's level of wellbeing. This method is mostly used in the health care sector but with certain modification it can be used also in the case of sport activities which also bring utility to those performing them (Robinson, 1993). The CUA method was created as a reaction to how to value outputs that cannot or should not be valued in monetary terms, when the form of measuring outputs is useful. It is based on comparing the increase in resources with the results, which we express in the form of benefits from the program, project, activity, etc. Questionnaires use point scales or scales in which the user (respondent) expresses a feeling of satisfaction / achieved benefit. The essence is the subjective statement of the respondent about the expectation of the flow of benefits, while possible expectations are arranged in scales from one extreme to the other (Ochрана, 2004).

As part of the survey, teachers had to evaluate pupils whilst the pupils had to evaluate themselves whether they improve in these skills thanks to visits to the La Skala climbing center. In other words, they had to evaluate the benefits that come from climbing in the center in terms of improving physical and mental properties, as shown in Table 1 in the theoretical part. We divided the pupils' evaluations according to whether they visit the climbing center regularly during physical education classes or they were there only for a demonstration lesson.

The calculation of costs is specific in this case, as pupils do not pay at school or at the climbing center. We therefore chose the gross average hourly wage of a primary school teacher, which is at the level of € 7.16 / hour for 2020 in the event that pupils do not visit the climbing center, or were only there for a demonstration class. If pupils go to a climbing center as part of physical education classes, we have determined the costs according to the entrance fee, which is € 5.5 / hour for people under 26 years of age.

Subsequently, we used a modified formula, the CUA method is commonly used in healthcare (e.g. Lauapcis et al., 1996; Dalziel et al., 2006; Kepler et al., 2012), so we modified the inputs and outputs:

$$CUA = \frac{\text{Costs in the Climbing Centre} - \text{Costs in the school}}{\text{Climbing Centre benefits} - \text{The Benefits of climbing in the school}} [1]$$

Pupils visit the climbing center on average 2 times a month, a total of 137 students. We evaluated the school year 2019/2020, but only up to March 2020, when the center was closed due to COVID-19, i.e., a total of 6 months. The cost is € 9,042. For pupils who do not visit the center, it is also 6 months, because schools also remained closed, the cost in this case is € 9,794.88. The results of the analysis are presented in the next section.

Results

The center is located in the regional city of Žilina and was opened to the public on September 15, 2018. The estimated comprehensive costs were approximately € 2,000,000. The total climbing area is 3,530 m². The number of lines on the climbing wall is 125, the number of routes is about 400 and the number of boulders is 100. As part of special equipment, there is a speedwall, moonboard, campus, automatic self-locking devices, top rope lines, climbing holds from various manufacturers, landing zone along the whole length of the boulder and a kid's corner. The building has changing rooms for visitors, restaurant, reception, small gym and a shop.

The number of registered visitors in the La Skala climbing center from its opening in September 2018 to the closing due to the coronavirus pandemic in March 2020 developed as follows. A total of 44,889 visitors are registered, of which 18.81% (n = 8,444) are children under 15, 3.98% (n = 1,791), children under 18, 60.75% (n = 27,268), men and women 16.45% (n = 7,386). Most members, 3,770, registered in November 2019. Men make up the largest group of members. The second largest group consists of children under 15 years of age, which falls into the school age of primary schools.

Climbing for children attending schools in Žilina is provided free of charge as part of physical education classes, thanks to a co-creation initiative. The main partners of this initiative are:

- NGO "Climbing club La Skala", which came with the idea of providing this service for children for free;
- the city of Žilina, which provided the plot of land for building the center for the symbolic rent of € 1/year and furthermore provides subsidies for the NGO;
- companies who sponsor the center.

Public and private schools cannot be considered as a partner in this co-creation initiative, since they are "only" passive consumers of the service. However, as consumers, or in other words clients, they provide valuable feedback and also data on benefits for our analysis.

First, we present an evaluation of the benefits of teachers, which, however, does not enter into the CUA analysis, because the usefulness in the analysis is to be evaluated by the users themselves. However, teacher evaluation is a certain objectifying factor, as they do not evaluate themselves, but objectively assess their pupils.

Of the 16 teachers involved, 7 regularly visit the climbing center with their pupils as part of physical education classes, and all have rated the usefulness at the highest level (score 5). The specific benefits were perceived by e.g., in improving fitness, overcoming obstacles, greater prudence, greater safety when climbing, higher teamwork and support for pupils among themselves. One teacher stated: "The girls who take part in these classes for the second year can see progress - some had to overcome a fear of heights, others were not physically strong enough, or did not have the correct climbing technique. We started at the easiest levels (4-, 4, 4+), now these girls can overcome walls with a difficulty of 6- to 6+. There is also visible progress among the boys, they try to motivate each other to perform better, they can see that they enjoy it and work to improve, then they go to climb in their free time, some with the whole family."

In terms of pupils, 28.4% of the research sample consisted of boys and 71.6% of girls, with 66% attending secondary school and the remaining 34% attending primary school. We divided the evaluation of usefulness according to whether they attend the climbing center regularly during physical education classes (group A - 84 pupils) or there was only a demonstration lesson and they practice climbing only in physical education classes at school (group B - 187 pupils). A summary of the answers is in Table 3, while in the analysis we took into account only those factors where the standard deviation was not too high. The evaluation was performed on a scale of 1-5, where 1 is the worst, the least and 5 is the most, the best.

Table 3 Evaluation of the benefits of the climbing center by pupils

Skills	Benefit	Evaluation group A		Evaluation group B	
		N = 137		N = 114	
		Mean	Std. Deviation	Mean	Std. Deviation
Physical abilities	Increase in muscle strength	2.90	1.88	2.70	1.92
	Increase in muscle volume	3.54	2.13	3.60	1.61
	Increased endurance skills in climbing	4.67	1.64	3.18	1.10
	Did not notice any changes	1.88	1.64	2.15	1.52
Mental abilities	I'm braver	3.43	1.87	2.00	1.81
	I trust my classmate more	3.66	2.35	4.12	2.17
	The joy of overcoming obstacles	3.08	1.59	1.70	1.43
	Pushing your own limits (goals)	4.20	1.24	3.10	1.58
	Did not notice any changes	2.99	1.78	2.83	1.53
Total		3.37	3.37	x	2.82

Source: own

The data from Table 3 and the costs calculated in the Research design section were fitted to the formula [1], we thereby calculated the cost effectiveness of the climbing literacy project for primary and secondary school pupils using the CUA method (Table 4).

Table 4 Cost effectiveness of a climbing literacy project for pupils

Cost		Utility		$\frac{\Delta cost}{\Delta utility}$
Group A	Group B	Group A	Group B	
9,042.00	9,794.88	3.37	2.82	-1,363.36

Source: own

Based on the results, we can say that the climbing literacy project for children and youth is cost-effective (CUA = - 1,363.36 €), which means that climbing in physical education classes in a climbing center brings more benefits for pupils than climbing as part of classic school lessons.

Discussion and conclusion

The aim of the paper was to analyze and evaluate the project of the La Skala climbing center, based on which primary and secondary school pupils in a selected district in Slovakia had the opportunity to attend a climbing wall during physical education classes and on this example, we verified the applicability of the CUA method.

La Skala provides climbing for primary and secondary school pupils in the district of Žilina free of charge, thanks to a co-creation initiative, where citizens or NGOs are involved in the initiation and / or design of public services, with the aim of creating public value. In this case, the initiator was the NGO Climbing Club La Skala which came up with the idea of providing this service for children for free. The city of Žilina, who joined as a cooperating partner, provided the plot of land for building the center for the symbolic rent of € 1 / year and furthermore provides subsidies for the NGO. This is in line with the findings of Nemec et al. (2015) who stated that local governments usually do not initiate co-creation. The center also uses donations from sponsors as part of this co-creation initiative. Subsidies from the city and donations thereby make it possible to provide climbing services for children and young people during physical education classes free of charge. The analysis showed several benefits for pupils, namely 38.28% of pupils noticed an increase in muscle strength and 28.90% noticed an increase in endurance skills. On the mental abilities side, pupils most noticed they were braver, this psychological change can be associated mainly with overcoming a fear of heights.

The limiting factor of this study is a relatively small sample, which is linked to only one region of the Slovak Republic, as well as the shortness of the observed period (the climbing center was established in September 2018). On the other hand, in this sample, we demonstrated the use of the CUA method, which is commonly used in healthcare. By modifying the formula, we applied this method to the field of sports, specifically the project of climbing literacy for children and youth. The results of CUA point to the benefits of this project for pupils, within the verbal evaluation it was also positively evaluated by teachers. Future research in this area could take into account other factors and focus, for example, on the therapeutic effects of climbing, thus deepening the utility analysis to health aspects as well. For example, Heitkamp et al. (2005) in a study with adolescents, reported increased isometric strength of spinal flexors and extensors, higher spinal rotator strength, and also higher spinal flexibility after a 10-week program. The health effects of climbing and its aspects have also been addressed by other authors Fleissner et al., (2010); Muehlbauer et al. (2013); Watts et. al. (2003).

In conclusion, we can state that the project of climbing literacy for children and youth in the climbing center La Skala is both more effective (brings higher utility) and less costly than climbing at school.

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