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Physical performance in masters' degree students in Exercise and Sport Sciences related to the motor learning approach

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ABSTRACT

Physical activities (PA) can be characterised by a cognitive approach or an ecological-dynamic approach. Currently, no emphasis is given in the master's degree in sports sciences to the different effects of exercise in the two different forms of delivery: prescriptive teaching and heuristic learning. The objective was to measure levels of physical performance in students and test for associations between the effects of exercise and the type of learning approach. Thirty-eight sports science students were divided into two groups according to the teaching/learning methodology used in their training: cognitive (CG) and dynamic ecological (EDG). A battery of tests was administered: squat jump (SJ), countermovement jump (CMJ), countermovement jump free arms (CMJ-FA), and stiffness test (ST). A questionnaire on daily physical activity was administered. The data collected were statistically processed. Statistically significant associations emerged between outcomes and groups ($P < 0.05$): 37% of CGs and 26% of EDGs used motorised vehicles at least once a week; only 5% of CGs and 26% of EDGs walked daily; 100% of CGs and 79% of EDGs practised PA continuously; CGs performed better in CMJ-FA and ST. The two approaches differ in their impact on daily, structured physical activity and performance effects.

KEYWORDS: learning approach; physical activity; lifestyle promotion; reproductive style; productive style.

INTRODUCTION

The practice of physical and sporting activity can be stimulated by many factors, such as the mode of administration: self-managed or completely managed by professionals. This study arose from the need to test physical and sporting activity levels in particular contexts and the effects of different approaches on performance levels.

Physical and sporting activities represent forms of bodily movement generated by skeletal muscles and involving a certain amount of energy expenditure for a variety of purposes, from moving from one place to another to manipulating objects to performing sports at a high level (World Health Organization, 2021; 2022b). Various evidence attests to the health benefits of physical activity and sport, such as reducing the risk of dysmetabolic and cardiovascular diseases (Warburton, Charlesworth, Ivey, Nettlefold, & Bredin, 2010). The possibilities of physical activity are manifold, from activities performed by individuals in everyday life as active participants within their social and physical environment to activities practised in structured settings such as wellness or sports centres (Mieziene et al., 2021; Sherif, 1948). In addition, self-managed or expert-led physical-sports activities are distinguished.

The latest evidence shows alarming data, there is a high rate of the population living in a sedentary state or with low levels of physical and/or sporting activity compared to the recommended standard of at least one hour per day of moderate to vigorous activity (MVPA) and, moreover, participation in physical activity tends to decline with age (Kimm et al., 2000; Patterson et al., 2018). The latest reports estimate that 27.25% of the world's population does not achieve the levels of physical activity recommended by the WHO to improve

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and protect their health (World Health Organization, 2022a). We do not know the reasons for these trends. We can speculate that we attribute them to a lack of time, economic, social, and cultural factors, adequate facilities, or stimulating proposals that encourage individuals to engage in such activities.

The International Health, Racquet & Sportsclub Association (IHRSA) report estimated the global health and sportsclub industry turnover at USD 87.2 billion (IHRSA, 2009). However, this fails to counter the increase in sedentariness not only in the domestic sphere but also in travelling from place to place and in the workplace (Park, Moon, Kim, Kong, & Oh, 2020). In a study conducted in Norway, Morseth and Hopstock (2020) showed an increase from 16% in 2001 to 28% in 2016 in continuous physical activity. However, they found an increase in sedentary work activity from 53% in 2007 to 57% in 2016. Studies, especially in developed and developing countries (Silveira et al., 2022), show high numbers of cases of overweight and obesity and various cardiovascular and postural problems linked to a lack of physical and sporting activity. Technological development has caused a decrease in physical activity and, at the same time, an increase in sedentary activities, such as screen-based entertainment and digital communication, and mobile phones (Borraccino et al., 2009; Woessner et al., 2021), for example, Europeans spend 40% of their free time (2.7 hours a day) watching television. The previously mentioned studies and reports effectively elucidate the current situation and trends concerning the practice of sports that are not in line with the WHO recommendations, and this points to the need to promote physical activity not only in structured settings but also in everyday life contexts through strategies aimed at developing healthy habits ranging from moving from one place to another to active breaks within work contexts that tend to be sedentary (St-Onge, Samani, & Madeleine, 2017). However, these studies do not fully elucidate the causes.

Training is the means to improve health and sports performance. It stimulates learning and improving skills and the emergence of functional, psychological and social adaptive responses. In general, the proposed physical and sports activity formats could be distinguished in various ways, including by the different ways in which they are performed and the types of learning they trigger (Raiola, 2017; Raiola & Di Tore, 2017). Thus, activities based on the cognitive approach and activities based on the dynamic ecological approach can be distinguished. In the first case, prescriptive teaching is used by coaches/instructors and practitioners of physical and sporting activities to promote the learning of technical and physical skills according to a reproductive style (Goldberger, Ashworth, & Byra, 2012; Mosston & Ashworth, 1986): the teacher, coach or athletic trainer prescribe exercises to the student to stabilise and refine motor programmes (Keele & Summers, 1976) through repetition of the gesture. On the other hand, the ecological-dynamic approach considers the individual in his or her entirety and complex interaction with the environment (Gibson, 1979), not limiting itself to aspects of internal coordination. Heuristic learning stimulates the emergence of spontaneous (heuristic) solutions to movement problems, exploiting executive variability to seek appropriate, original and creative solutions (D'Isanto, Altavilla, Esposito, D'Elia, & Raiola, 2022a; D'Isanto, Di Domenico, Aliberti, D'Elia, & Raiola, 2022b) through a self-organising mechanism (Edelman, 1987; Jacobs & Michaels, 2007).

Many studies have contributed to finding possible reasons for the sub-optimal levels of physical and sporting activity practice encountered, above all in industrialised countries, which generates a high expenditure of economic resources. Still, not as many studies have given adequate importance to the different teaching-learning methodologies used in promoting and administering these activities. Knowing the effects that different teaching methodologies generate on the potential users of a given context in terms of participation and improved functions can contribute to optimising existing proposals and developing new ones. Before solving this critical aspect, it would be necessary to know the levels of physical activity in specific contexts to obtain data that can also be compared with other local contexts. Furthermore, the difference in effectiveness between the approaches being compared is not fully known. There is a need, even for future kinesiologists, who also deal with teaching methods in their training, to understand how to apply an unusual approach, such as the dynamic ecological approach, which is characterised by heuristic learning through a productive style.

Therefore, the study aims to find out the levels of physical and sporting activity useful for the maintenance of well-being and health as indicated by the WHO recommendations for a specific context, which is that of potential sports kinesiologists, and to verify any relationships with the teaching methodology used and between these and the performance levels possessed.

METHODS

Study participants

The initial sample (Table 1) consisted of 51 students from the Faculty of Exercise and Sport Sciences at the University of Salerno with an average age of 24± 2.8 divided into 20 females and 31 males (average BMI 24.05± 4.84). The sample was selected for convenience. After receiving detailed information on the objectives and procedures of the study, each participant gave consent to participate and to process personal and sensitive data following the legislation currently in force.

The entire initial sample was preliminarily asked a question concerning the mode of practice of the physical activity or sport, i.e., totally managed by the instructor/coach (reproductive style) or self-managed (productive style) (Table 2). This resulted in two groups: cognitive (CG), for those who stated they practised instructor-managed activities, and dynamic ecological (EDG), for those who stated they practised self-managed activities.

The final sample, therefore, consisted of 38 statistical units divided into two groups, CG and EDG, whose characteristics are shown in Table 3.

Instruments

A Pegaso professional altimeter scale was used to collect anthropometric data on weight and height (in kg and m) from which the body mass index (BMI) was calculated. A 7-question questionnaire compiled with Google Forms based on the Physical Activity Questionnaire (IPAQ) was used, adapted with questions related to mode of travel from place to place, amount of MVPA, and continuous PA practice. Quantitative data were collected using optoelectronic instrumentation with photocells (Microgate's Optojump) equipped with two transmitter bars and a high-resolution, high-frequency video camera.

Table 1. Sample description with mean (M) and standard deviation (SD).

N= 51; *F*= 20, *F*= 31	Age (years)	Weight (kg)	Height (m)	BMI (kg/m²)
Mean	24	73.4	1.74	24.05
Standard deviation	2.8	17	0.08	4.84

Table 2. Preliminary question to divide the sample into two groups according to the type of physical activity practised: self-directed or coach-directed.

Question	Answer	Allocation group
When practising physical activity, you prefer one activity:	1. Fully managed by the instructor/coach	Cognitive approach
	2. Self-managed	Ecologic dynamic approach

Table 3. Age and anthropometric characteristics of the two groups.

Group	Age (years)	Weight (kg)	Height (m)	BMI (kg/m²)
CG	24.05± 2.44	73.63± 14.19	1.73± 0.08	24.46± 4.19
EDG	24.16± 2.22	75.42± 22.41	73.1± 16.53	24.61± 6.47

Procedures

Prior to the administration of the qualitative and quantitative tests, the aims, procedures, and possible risks were explained, and an Informed Consent form was asked to be signed. A preliminary question was then administered to the initial sample of 51 statistical units, selected from among the Sport Sciences (LM-68) students at the University of Salerno, to divide the sample into two groups of 19 statistical units each, CG and EDG. The question was formulated in such a way as to give clear and representative answers. The question was, 'When practising physical activity, do you prefer one activity with two possible answers:

1. Fully managed by the instructor/coach
2. Self-managed

The number of participants who responded that they preferred self-managed activities was 19, while the number of participants who gave the alternative response was 32. Therefore, in order to have the same number of sample units for both groups, all respondents who answered that they practised activities according to the dynamic ecological approach and were included in EDG were selected, and 19 out of 32 individuals who answered that they practised activities based on a cognitive approach and were included in CG were selected by simple random sampling. The final sample of 38 statistical units divided into two groups of 19 individuals each (CG and EDG) responded to a series of 7 questionnaire questions (Table 4) drafted with Google Forms and sent via institutional e-mail. The questionnaire was based on PAQs adapted on the following topics: mode of travel from one place to another, MVPA levels, and practice of continuous physical activity or sport.

Anthropometric parameters were then measured using a Pegaso weight scale and altimeter (weight, height, and BMI). The quantitative data acquisition process took place in a controlled laboratory environment through the succession of several steps and lasted approximately 20 minutes for each individual. Quantitative data were acquired through a specially prepared test protocol with Optojump instrumentation.

The protocol consisted of four tests investigating the squat as an expression of fundamental movement skills (FMS), in its different expressions, and stiffness of the lower limb as a reliable measure to determine dynamic properties related to other functions such as walking and running. The administration sequence had a set order:

Table 4. Questionnaire sent to participants via the Google Forms platform.

	Question	Answer							
1	How many days a week do you usually use a motor vehicle?	0	1	2	3	4	5	6	7
2	How many days a week do you usually use your bicycle?	0	1	2	3	4	5	6	7
3	How many days a week do you walk from one place to another?	0	1	2	3	4	5	6	7
4	How many days a week do you usually do vigorous physical activity at home or in the garden?	0	1	2	3	4	5	6	7
5	How many days a week do you usually do moderate physical activity at home or in the garden?	0	1	2	3	4	5	6	7
6	Do you currently practise physical activity or sport in a quantitative manner?	Yes				No			
7	How many times a week do you usually engage in physical activity or sports?	1	2	3	4	5	6	7	

1. Squat jump (SJ);
2. Countermovement jump (CMJ) with hands at hips;
3. Countermovement jump arms free (CMJ-FA);
4. Stiffness test (ST)

A data acquisition setting was specially prepared inside a motion analysis laboratory measuring 4 x 6 m base and 4 m height. The 60 x 90 cm acquisition area was set up on a PVC floor, and Microgate Optojump bars were placed on the longest sides (Figure 1).

Before the start of the test session, participants completed a 10-minute dynamic warm-up protocol consisting of movement preparation (squats), exercise bikes, dynamic stretching, running, and jumping exercises. Measurements of jump heights (cm), flight times (s) for the jump tests and contact times (s), flight times (s), flight height (cm) and reactive strength index (RSI), obtained from the ratio of flight height to contact time, for the stiffness test were recorded on digital media. Each measurement was repeated three times with a 90-second recovery, and the average was calculated and used for the analysis.

Statistical analysis

The descriptive data were presented as mean and standard deviation (SD). The normality distribution of the data and the homogeneity of the variances were confirmed by the Shapiro-Wilk and Levene tests ($P > 0.05$), respectively. The Chi-square test was used for associations between daily, organised, and continuous physical activity practice and group membership (C-G and ED-G). A Student's t-test for independent samples was used to test for differences between the various quantitative parameters measured in C-G and ED-G. Cramer V was used to measure the strength of the association, interpreted using the following criteria: small (V= 0,10), medium (V= 0,30), and large (V> 0,50). Data was analysed using the Statistical Package for Social Science software (IBM SPSS Statistics for Windows, version 27.0. Armonk, NY). Significance was set at $p < 0.05$.

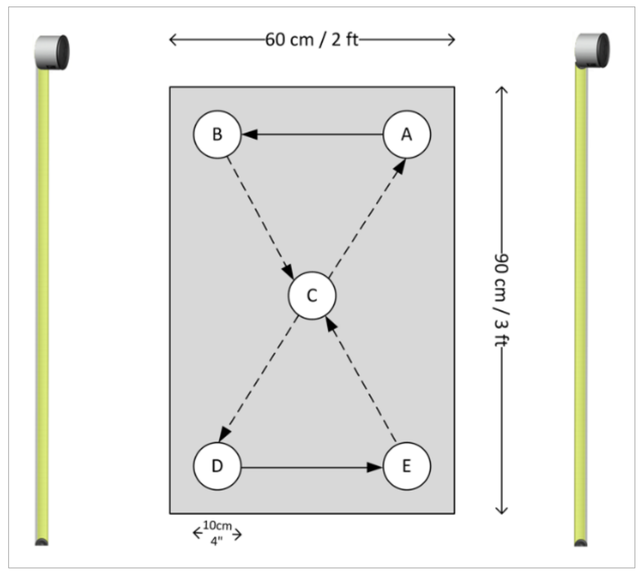

Figure 1. Schematic of the data acquisition area provided by Optojump Microgate.

RESULTS

The answers to the first section of the questionnaire, shown in the histogram (Figure 2), show that the entire sample (n= 38/38) used a motor vehicle at least once a week to get from one place to another, the majority (n= 31/38; 81,58%) did not use a bicycle and only 6 (15,79%) walked to get from one place to another 7 days a week. Considering the groups, the use of motor vehicles at least once a week was higher in CG, 36,84% (n= 7/19), compared to 26,32% (n= 5/19) in EDG; the bicycle was used for commuting at least once a week by 26,32% (n= 5/19) of CG and 10,52% (n= 2/19) of EDG; 5.26% (n= 1/19) of CG walked to get from one place to another for all seven days of the week versus 26,32% (n= 5/19) of EDG. The contingency table summarises the frequency of responses the participants gave according to their group.

Figure 3 shows the answers to the second section of questions concerning the level of MVPA practised weekly by

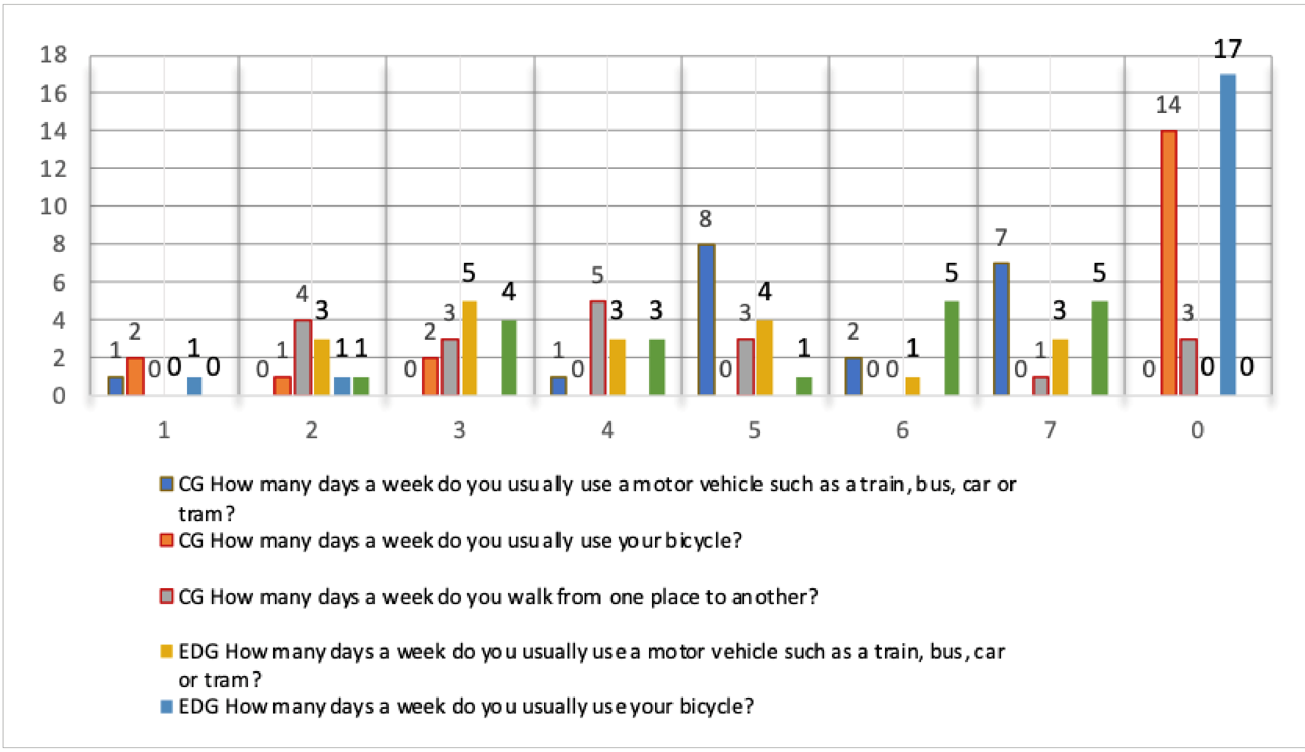

Figure 2. Weekly physical activity levels of CG and EDC for moving from one place to another and relative contingency table.

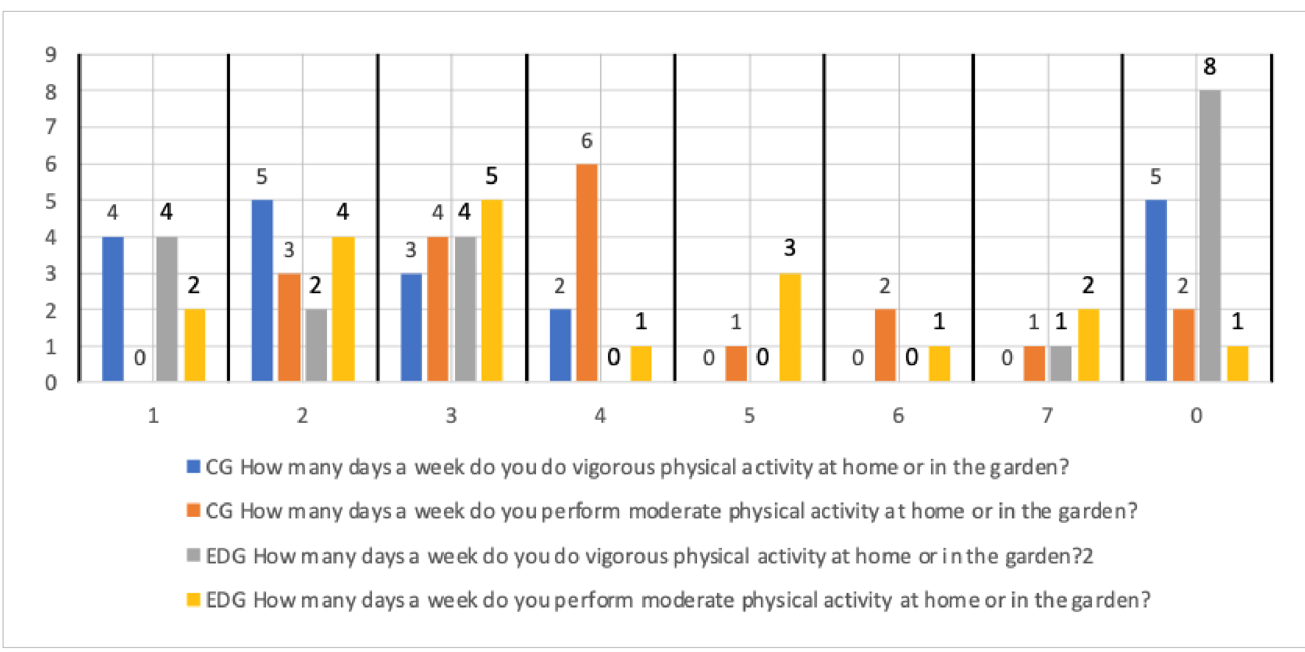

Figure 3. Weekly MVPA levels at home or in the garden with a contingency table.

the individual subjects within the different groups. 15,79% (*n*= 5/19) of EDGs responded that they practice MVPA 7 days a week compared to 5,26% (*n*= 1/19) of CGs, while 47,36% (*n*= 9/19) of EDGs do not practice MVPA on any day of the week compared to 36,84% of CGs. The qualitative data collected with adapted-IPAQ (Table 5) were further processed with χ^2 tests to check for associations between the answers given and the group. Table 6 shows, in even greater

Table 5. Overall results of the Chi Quadro test and degree of association with Cramer V.

	Group CG/EDG	Sign.	Cramer V
1	How many days a week do you usually use a motor vehicle such as a train, bus, car or tram?	0.039	0.591
2	How many days a week do you usually use your bicycle?	0.453	0.263
3	How many days a week do you walk from one place to another?	0.028	0.609
4	How many days a week do you usually do vigorous physical activity at home or in the garden?	0.362	0.379
5	How many days a week do you do moderate physical activity at home or in the garden?	0.614	0.343
6	Do you currently practise motor or sports activities on an ongoing basis?	0.034	0.343
7	How many times a week do you usually engage in physical activity or sports	0.038	0.556

Table 6. Descriptive statistics and differences between the groups for testing with Optojump Next (Microgate).

	Group	N	Mean	St. deviation	Sign.	Effect size
SJ elevation	CG	19	23.363 cm	8.144	0.21	0.42
	EDG	19	20.242 cm	6.873		
CMJ elevation	CG	19	25.942 cm	8.278	0.211	0.41
	ECG	19	22.736 cm	7.217		
CMJ-FA elevation	CG	19	29.894 cm	8.632	0.045	0.67
	EDG	19	24.478 cm	7.352		
ST RSI	CG	19	0.534	0.407	0.03	0.71
	EDG	19	0.306	0.164		

detail, for the two questions, the association between group membership and the response given by the participants.

The graph (Figure 4) shows the frequency of answers to the last questionnaire question concerning the amount of continuous physical or sporting activity practised. It emerges that 100 % (n= 19/19) of CG and 78,95 % (n= 15/19) of EDG practised continuous physical and sporting activity. The same results are summarised in Table 6, which shows the response associations.

Statistically significant relationships emerged (p= 0.038) to the first question "How many days a week do you habitually use a motor vehicle such as train, bus, car or tram?" (*Cramer V*= 0.591), to the third "How many days a week do you walk from one place to another?" (p= 0.028; *Cramer V*= 0.609), to the sixth "Do you currently engage in physical or sporting activities on an ongoing basis?" (p= 0.034; *Cramer V*= 0.343) and to the seventh "How many times a week do you habitually engage in physical or sporting activities?" (p= 0.038; *Cramer V*= 0.556), while no associations (p> 0.05) emerged in the other 3 questions.

Table 6 summarises the mean and standard deviation results of the quantitative tests performed with Optojump Next instrumentation. Higher values were shown in all four tests in CG: specifically, CG gave higher results in SJ (+3,12 cm; 15%), CMJ (+3,2 cm; 14%), CMJ-FA (+5,41 cm; 22%), and in ST-RSI (+0,22; 71%). The students' t-tests for independent samples showed statistically significant differences only for the CMJ-FA (p= 0,045) and ST (p= 0,03) parameters, with moderate effect size values (0.67 and 0.71, respectively). In contrast, for the SJ and CMJ parameters, the differences were not statistically significant (P> 0,05). The contingency tables from Figures 2, 3, and 4 are reported in Table 7, 8, and 9.

DISCUSSION

The study, in its first part, sought to quantify the levels of physical and sporting activity of the two groups to ascertain whether the minimum levels recommended by the WHO for the maintenance of good physical, mental and social health and well-being were achieved within this context and whether these levels were attributable to the type of learning approach used. The data collected in the first three questions showed a fairly strong dependence on motor vehicles to move from place to place, low bicycle use, and not high levels of walking. Specifically, the responses to the first question

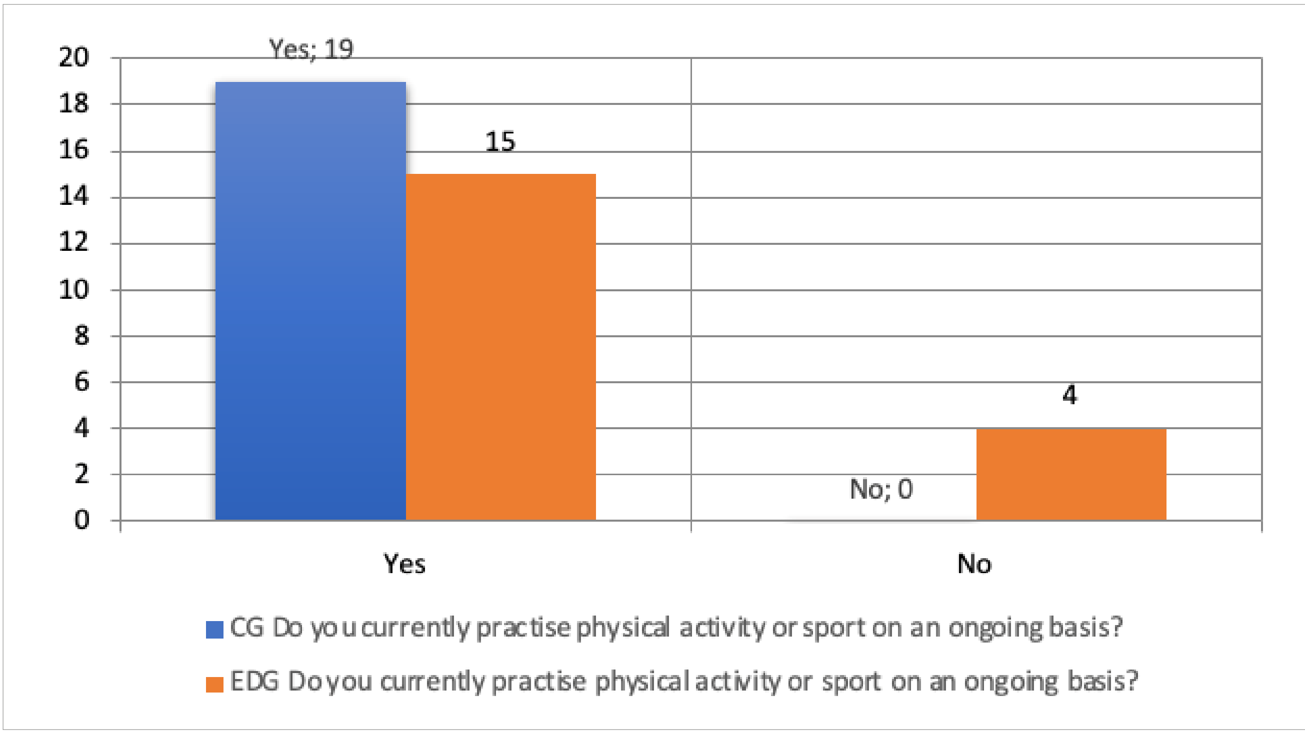

Figure 4. Level of practice of physical activity or sport on an ongoing basis with contingency table.

Table 7. Contingency table of weekly physical activity levels of CG and EDG to move from one place to another.

		How many days a week do you usually use a motor vehicle such as a train, bus, car, or tram?							Total
		1	2	3	4	5	6	7	
Group	CG	1	0	0	1	8	2	7	19
	EDG	0	3	5	3	4	1	3	19
Total		1	3	5	4	12	3	10	10

		How many days a week do you usually use your bicycle?				Total
		0	1	2	3	
Group	CG	14	2	1	2	19
	EDG	17	1	1	0	19
Total		31	3	2	2	38

		How many days a week do you walk from one place to another?							Total
		0	2	3	4	5	6	7	
Group	CG	3	4	3	5	3	0	1	19
	EDG	0	1	4	3	1	5	5	19
Total		3	3	5	7	8	4	5	6

showed that all subjects used a motor vehicle at least once a week to move from place to place; CG subjects showed a higher propensity to use motor vehicles throughout the week, amounting to 36.8% (*n*= 7/19) compared to the other group showing a frequency of 3 out of 19 (15.8%). A statistically significant association (p= 0.039) was found between the habits of using motor vehicles and the group they belonged to. Responses to the second question showed low bicycle use. In fact, 73.7% (*n*= 14/19) of CG and 89.5% (*n*= 17/19) of EDG responded that they never use a bicycle for commuting. This finding is fairly unanimous; thus, no association (p> 0.05) between response and group was found. Responses to the third question show that only 5.3% of CG (*n*= 1/19) and 26.3% (*n*= 5/19) of EDG walk to get from one place

Table 8. Contingency table of weekly MVPA levels at home or in the garden.

		How many days a week do you usually do vigorous physical activity at home or in the garden?						Total
		0	1	2	3	4	7	
Group	CG	5	4	5	3	2	0	19
	EDG	1	7	4	2	4	1	19
Total		6	11	9	5	6	1	38

		How many days a week do you usually do moderate physical activity at home or in the garden?							Total
		0	2	3	4	5	6	7	
Group	CG		3	4	6	1	2	1	19
	EDG		1	6	4	3	1	3	19
Total			4	10	10	4	3	4	38

Table 9. Contingency table of Level of practice of physical activity or sport on an ongoing basis.

		Do you currently practice physical activity or sport on an ongoing basis?		Total
		Yes	No	
Group	CG	0	19	19
	EDG	4	15	19
Total		4	34	38

		How many times a week do you usually engage in physical activity or sports?						Total
		0	2	3	4	5	6	
Group	CG	0	1	6	8	2	2	19
	EDG	4	1	11	3	0	0	19
Total		4	2	17	11	2	2	38

to another. This question appears to have a strong (*Cramer V*= 0,609) and statistically significant (*p*= 0,28) association. Thus, the type of approach used in physical activity has influences on the mode of travel: subjects who prefer PA modes that stimulate heuristic learning seem to be more aware that reducing motor vehicle use habits in favour of active travel is key to countering sedentary lifestyles and promoting healthy lifestyles (Panter, Desousa, & Ogilvie, 2013). In recent years, the trend of passive transportation seems to be increasing, and this gives rise to several environmental issues such as CO^2 emissions, noise, and safety of individuals (Campisi, Akgün, Ticali, & Tesoriere, 2020; Van Wee & Ettema, 2016) in addition to economic aspects and those related to individual and public health as being responsible for reduced physical activity and road accident hazards (De Nazelle et al., 2011). The other impactful finding is the low use of bicycles to get around and the low habit of walking for at least one hour to get from place to place in both groups. Walking and bicycling can be an effective mode of daily physical activity to promote healthy lifestyles and maintain good health and well-being (Das & Horton, 2012; Pucher, Buehler, Bassett, & Dannenberg, 2010). However, these activities, especially bicycle use, are related to several conditions, including natural, infrastructural, and social conditions that may not be excellent in the geographic context under study (Šťastná, Vaishar, Zapletalová, & Ševelová, 2018). Fostering such practices would require addressing these shortcomings and, therefore, activating awareness campaigns concerning the benefits of such activities and adapting or creating safe and functional infrastructure.

Regarding weekly PA levels, the responses showed that 36.8% (*n*= 7/19) of CG and 47.4% (*n*= 9/19) of EDG did not achieve MVPA levels on any day of the week, while only 5.3% of CG and 15.8% of EDG reported practising MVPA every day of the week. Their responses had no relationship with their group ($p > 0.05$). These data sharply contrast WHO recommendations of at least one hour of moderate to vigorous physical activity daily, but in line with global trends over the past decade. A recent WHO report estimated globally that more than 25% of adults and 80% of adolescents are insufficiently physically active (World Health Organization, 2022a). In the last part of the questionnaire, attention was focused on the continuous practice of physical activity or sports and weekly frequency. All statistical units (*n*= 19/19) belonging to CG responded that they practised PA continuously with an average frequency of 3.9 workouts per week. In contrast, for EDG, 79.9% (*n*= 15/19) responded that they practised sports continuously with an average frequency of 3.13 workouts per week. There was a statistically significant (*Cramer V*= 0.343) mean association (*p*= 0.034) between continuous PA practice and membership group and between weekly frequency and membership group (*p*= 0.38; *Cramer V*= 0.556). This evidence shows that there is a greater propensity to engage in structured physical activity for individuals characterised by a reproductive learning style, which falls under the cognitive approach. At the same time, free health-promoting solutions, such as walking to get from one place to another and avoiding motor transportation, are more accepted by individuals characterised by a productive learning style, which is typical of the dynamic ecological approach.

The last part of the study verified the differences in the effectiveness of different approaches to learning characterising physical and sports activities compared at performance levels. Important evidence emerged that showed statistically significant differences in only a few aspects. CG subjects performed better in all four parameters tested. For CMJ-FA and ST, the differences were statistically significant (CMJ-FA *p*= 0.045; ST *p*= 0.03), while for SJ and CMJ, the differences found were not statistically significant (*P*> 0,05). Previous studies have shown differences in efficacy in favour of the dynamic ecological approach versus the cognitive approach after the administration of specially structured training protocols. However, unlike the present study, which was concerned with parameters related to force expression in a controlled environment, they considered social skills, environmental adaptation, and problem-solving in variable contexts (Altavilla, Aliberti, D'Isanto, & Raiola, 2022; Thornton et al., 2017). This finding suggests that parameters tested through structured exercises in an invariable environment are more favoured by a cognitive approach. So, improving morphological, energetic and coordinative parameters in a controlled environment would be more stimulated by prescriptive methodologies involving a reproductive teaching style. In contrast, the heuristic method involving a productive style would be more suitable for developing open-ended and context-varying skills and competencies. Such evidence is well supported in the literature. Prescriptive-type activities, such as those totally managed by the teacher/coach, stimulate the reproduction of knowledge, and this can be useful in stimulating the learning of well-structured, complex, and controlled skills that ensure the success of all performers (Mosston & Ashworth, 2008). They do not, however, consider the needs, ideas, and personal characteristics of the individual (Chow, Davids, Hristovski, Araújo, & Passos, 2011). Self-managed activities, on the other hand, stimulate the production of new knowledge, which, in the motor-sport domain, corresponds to the development of new movement solutions concerning various contexts (Kulinna & Cothran, 2003; Mosston & Ashworth, 1985) as they involve individuals in decision-making processes and focus on cognitive, social and personal development (Gray, 2013). Other studies may turn their attention to parameters more related to skills and competencies in variable environments.

A limitation found in the present study is the lack of data on the type of physical activity or sports practiced. Indeed, it is unclear why statistically significant differences were found only in CMJ-FA and ST, while none were found in SJ and CMJ. Given that arm swinging in the CMJ would be related to a higher degree of sport specificity (Laffaye, Wagner, & Tombleson, 2014), experienced jumpers, for example, would show higher levels of performance than athletes of other specialities (Slinde, Suber, Suber, Edwén, & Svantesson, 2008), it needs further investigation that goes to consider the physical and sporting activity practised individually by the subjects to verify whether the differences are to be associated with the speciality practised or due to chance. Another limitation is the sample size, which appears to be low compared to the context studied.

CONCLUSIONS

The present study aimed to increase knowledge concerning the impact of the type of learning approach used on physical activity levels in specific settings. Relationships between approaches and lifestyles emerge. Based on these findings, appropriate solutions should be developed, also taking into account these aspects, which aim to promote healthy lifestyles toward achieving the minimum levels of MVPA recommended by the WHO. An interesting finding, consistent with evidence from other studies, is that activities oriented toward a cognitive approach are more conducive to the development and refinement of structured gestures typical of low-variable environments, while activities characterised by a dynamic ecological learning approach are more conducive to the improvement of skills typical of variable environments. The study aimed to provide kinesiologists, athletic trainers, and personal trainers with more knowledge concerning programming training processes that aim to achieve specific goals that are different for each individual. For example, prescriptive exercises are recommended for training structured skills with little scope for variation, while heuristic learning is more suitable for improving skills that enjoy greater executive variability. Further studies will be necessary to verify the effects of using the two approaches in different sports disciplines: differences between situational and cyclic sports may probably emerge.

REFERENCES

Altavilla, G., Aliberti, S., D'Isanto, T., & Raiola, G. (2022). A comparison between ecological-dynamic and cognitive approach to improve accuracy in basketball shot. *Studia Sportiva*, *16*(1), 6-12. https://doi.org/10.5817/sts2022-1-1

Borraccino, A., Lemma, P., Iannotti, R. J., Zambon, A., Dalmasso, P., Lazzeri, G., Giacchi, M., & Cavallo, F. (2009). Socioeconomic effects on meeting physical activity guidelines. *Medicine & Science in Sports & Exercise*, *41*(4), 749-756. https://doi.org/10.1249/mss.0b013e3181917722

Campisi, T., Akgün, N., Ticali, D., & Tesoriere, G. (2020). Exploring Public Opinion on Personal Mobility Vehicle Use: A Case Study in Palermo, Italy. *Sustainability*, *12*(13), 5460. https://doi.org/10.3390/su12135460

Chow, J. Y., Davids, K., Hristovski, R., Araújo, D., & Passos, P. (2011). Nonlinear pedagogy: Learning design for self-organizing neurobiological systems. *New Ideas in Psychology*, *29*(2), 189-200. https://doi.org/10.1016/j.newideapsych.2010.10.001

Das, P., & Horton, R. (2012). Rethinking our approach to physical activity. *The Lancet*, *380*(9838), 189-190. https://doi.org/10.1016/S0140-6736(12)61024-1

De Nazelle, A., Nieuwenhuijsen, M. J., Antó, J. M., Brauer, M., Briggs, D., Braun-Fahrlander, C., Cavill, N., Cooper, A. R., Desqueyroux, H., Fruin, S., Hoek, G., Panis, L. I., Janssen, N., Jerrett, M., Joffe, M., Andersen, Z. J., van Kempen, E., Kingham, S., Kubesch, N., Leyden, K. M., Marshall, J. D., Matamala, J., Mellios, G., Mendez, M., Nassif, H., Ogilvie, D., Peiró, R., Pérez, K., Rabl, A., Ragettli, M., Rodríguez, D., Rojas, D., Ruiz, P., Sallis, J. F., Terwoert, J., Toussaint, J. F., Tuomisto, J., Zuurbier, M., & Lebret, E. (2011). Improving health through policies that promote active travel: a review of evidence to support integrated health impact assessment. *Environment International*, *37*(4), 766-777. https://doi.org/10.1016/j.envint.2011.02.003

D'Isanto, T., Altavilla, G., Esposito, G., D'Elia, F., & Raiola, G. (2022a). Heuristic Learning and Sport: Theoretical Lines and Operational Proposals. *Encyclopaideia*, *26*(64), 69-80. https://doi.org/10.6092/issn.1825-8670/14237

D'Isanto, T., Di Domenico, F., Aliberti, S., D'Elia, F., & Raiola, G. (2022b). Criticisms and perspectives of heuristic learning in physical education. *Pedagogy of Physical Culture and Sports*, *26*(2), 93-100. https://doi.org/10.15561/26649837.2022.0203

Edelman, G. M. (1987). *Neural Darwinism: The theory of neuronal group selection*. Basic Books.

Gibson, J. J. (1979). *The ecological approach to visual perception*. Lawrence Erlbaum Associates.

Goldberger, M., Ashworth, S., & Byra, M. (2012). Spectrum of teaching styles retrospectives. *Quest*, *64*(4), 268-282. https://doi.org/10.1080/00336297.2012.706883

Gray, P. (2013). *Free to learn: Why unleashing the instinct to play will make our children happier, more self-reliant, and better students for life*. Basic Books.

International Health, Racquet & Sportsclub Association (IHRSA) (2009). *The IHRSA Global Report 2009: The State of the Health Club Industry*. IHRSA.

Jacobs, D., & Michaels, C. (2007). Direct learning. *Ecological Psychology*, *19*(4), 321-349. https://doi.org/10.1080/10407410701432337

Keele, S. W., & Summers, J. J. (1976). *The Structure of Motor Programs*. Motor Control, Academic Press.

Kimm, S. Y., Glynn, N. W., Kriska, A. M., Fitzgerald, S. L., Aaron, D. J., Similo, S. L., McMahon, R. P.; & Barton, B. A. (2000). Longitudinal changes in physical activity in a biracial cohort during adolescence. *Medicine & Science in Sports & Exercise*, *32*(8), 1445-1454. https://doi.org/10.1097/00005768-200008000-00013

Kulinna, P. H., & Cothran, D. J. (2003). Physical education teachers' self-reported use and perceptions of various teaching styles. *Learning and Instruction*, *13*(6), 597-609. https://doi.org/10.1016/S0959-4752(02)00044-0

Laffaye, G., Wagner, P. P., & Tombleson, T. I. (2014). Countermovement jump height: gender and sport-specific differences in the force-time variables. *Journal of Strength and Conditioning Research*, *28*(4), 1096-1105. https://doi.org/10.1519/JSC.0b013e3182a1db03

Mieziene, B., Emeljanovas, A., Tilindiene, I., Tumynaite, L., Trinkuniene, L., & Kawachi, I. (2021). The Direct and Indirect Relationships of Environmental, Interpersonal and Personal Factors with High School Students Physical Activity: An Ecological Approach. *International Journal of Environmental Research and Public Health*, *18*(3), 874. https://doi.org/10.3390/ijerph18030874

Morseth, B., Hopstock, L. A. (2020). Time trends in physical activity in the Tromsø study: An update. *PLoS One*, *15*(4), e0231581. https://doi.org/10.1371/journal.pone.0231581

Mosston, M., & Ashworth, S. (1985). Toward a unified theory of teaching. *Educational Leadership*, *42*(8), 31-34.

Mosston, M., & Ashworth, S. (1986). *Teaching physical education* (3a ed.). Merrill Pub. Co.

Mosston, M., Ashworth, S. (2008). *Teaching physical education*. Retrieved from http://www.spectrumofteachingstyles.org/e-book-download

Panter, J., Desousa, C., & Ogilvie, D. (2013). Incorporating walking or cycling into car journeys to and from work: the role of individual, workplace and environmental characteristics. *Preventive Medicine*, *56*(3-4), 211-217. https://doi.org/10.1016/j.ypmed.2013.01.014

Park, J. H., Moon, J. H., Kim, H. J., Kong, M. H., & Oh, Y. H. (2020). Sedentary Lifestyle: Overview of Updated Evidence of Potential Health Risks. *Korean Journal of Family Medicine*, *41*(6), 365-373. https://doi.org/10.4082/kjfm.20.0165

Patterson, R., McNamara, E., Tainio, M., de Sá, T. H., Smith, A. D., Sharp, S. J., Edwards, P., Woodcock, J., Brage, S., & Wijndaele, K. (2018). Sedentary behaviour and risk of all-cause, cardiovascular and cancer mortality, and incident type 2 diabetes: a systematic review and dose response meta-analysis. *European Journal of Epidemiology*, *33*(9), 811-829. https://doi.org/10.1007/s10654-018-0380-1

Pucher, J., Buehler, R., Bassett, D. R., & Dannenberg, A. L. (2010). Walking and cycling to health: a comparative analysis of city, state, and international data. *American Journal of Public Health*, *100*(10), 1986-1992. https://doi.org/10.2105/AJPH.2009.189324

Raiola, G. (2017). Motor learning and teaching method. *Journal of Physical Education and Sport*, *17*(Suppl. 5), 2239-2243. https://doi.org/10.7752/jpes.2017.s5236

Raiola, G., Di Tore, P.A. (2017). Motor learning in sports science: Different theoretical frameworks for different teaching methods. *Sport Science*, *10*(Suppl. 1), 50-56.

Silveira, E. A., Mendonça, C. R., Delpino, F. M., Elias Souza, G. V., Pereira de Souza Rosa, L., de Oliveira, C., & Noll, M. (2022). Sedentary behavior, physical inactivity, abdominal obesity and obesity in adults and older adults: A systematic review and meta-analysis. *Clinical Nutrition ESPEN*, *50*, 63-73. https://doi.org/10.1016/j.clnesp.2022.06.001

Slinde, F., Suber, C., Suber, L., Edwén, C. E., & Svantesson, U. (2008). Test-retest reliability of three different countermovement jumping tests. *Journal of Strength and Conditioning Research*, *22*(2), 640-644. https://doi.org/10.1519/JSC.0b013e3181660475

Sherif, M. (1948). *An outline of social psychology*. Harper.

Šťastná, M., Vaishar, A., Zapletalová, J., & Ševelová, M. (2018). Cycling: A benefit for health or just a means of transport? Case study Brno (Czech Republic) and its surroundings. *Transportation Research Part F: Traffic Psychology and Behaviour*, *55*, 219-233. https://doi.org/10.1016/j.trf.2018.02.006

St-Onge, N., Samani, A., & Madeleine, P. (2017). Integration of active pauses and pattern of muscular activity during computer work. *Ergonomics*, *60*(9), 1228-1239. https://doi.org/10.1080/00140139.2017.1303086

Thornton, C. M., Kerr, J., Conway, T. L., Saelens, B. E., Sallis, J. F., Ahn, D. K., Frank, L. D., Cain, K. L., & King, A. C. (2017). Physical Activity in Older Adults: an Ecological Approach. *Annals of Behavioral Medicine*, *51*(2), 159-169. https://doi.org/10.1007/s12160-016-9837-1

van Wee, B., & Ettema, D. (2016). Travel behaviour and health: A conceptual model and research agenda. *Journal of Transport and Health*, *3*(3), 240-248. https://doi.org/10.1016/j.jth.2016.07.003

Warburton, D. E., Charlesworth, S., Ivey, A., Nettlefold, L., & Bredin, S. S. (2010). A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. *International Journal of Behavioral Nutrition and Physical Activity*, *7*, 39. https://doi.org/10.1186/1479-5868-7-39

Woessner, M. N., Tacey, A., Levinger-Limor, A., Parker, A. G., Levinger, P., & Levinger, I. (2021). The Evolution of Technology and Physical Inactivity: The Good, the Bad, and the Way Forward. *Frontiers in Public Health*, *9*, 655491. https://doi.org/10.3389/fpubh.2021.655491

World Health Organization (2021). *Physical activity fact sheet* (No. WHO/HEP/HPR/RUN/2021.2). World Health Organization.

World Health Organization (2022a). *Global status report on physical activity 2022*. World Health Organization.

World Health Organization (2022b). *Physical activity*. World Health Organization. Retrieved from https://www.who.int/news-room/fact-sheets/detail/physical-activity