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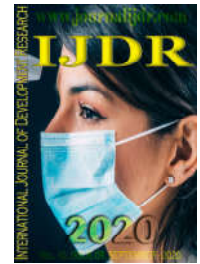
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EFFECTS OF ENVIRONMENTAL CONTEXT MANAGEMENT AND PARAMETERIZATION OF ANGEL JUMPING LEARNING ON THE MOTOR DEVELOPMENT OF STUDENTS AT THE EMERY PATRICE LUMUMBA HIGH SCHOOL IN BRAZZAVILLE (CONGO)

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ABSTRACT

Purpose: This study set out to assess the effects of environmental context design and parameterization of angel jump learning on students' motor development. **Methods:** 18 girls and 14 boys were submitted to 56 angel jumping lessons in a set up context (runway, springboard, moss 6mx3.60mx0.60m, 12m square walkway). They carried out tests to evaluate the strength of the upper limbs, the strength/speed of the lower limbs, the general dynamic coordination before and after learning the angel jump. **Results:** The results obtained showed significantly higher post learning values compared to the initial values for lower limb strength and speed ($0.37\pm 0.01m$ Vs $0.27\pm 0.01m$ and $0.51\pm 0.01m$ Vs $0.37\pm 0.01m$), upper extremity strength ($32.11\pm 0.90kg$ Vs $22.11\pm 0.90kg$ and $39.00\pm 0.88kg$ Vs $34.07\pm 0.92kg$), and general dynamic coordination (7.00 ± 1.03 Vs 5.44 ± 0.51 and 9.21 ± 0.89 Vs 7.43 ± 0.51) in girls and boys, respectively ($p<0.00$). **Conclusion:** These results suggest that spatial design and the parameterization of the learning of angel skipping promote students' motor development.

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INTRODUCTION

Physical and Sports Education (PES) contributes to the development of students, physical fitness and participates in fitness and good health throughout life by developing civic values (Delignières, 2020: 2). This discipline is made possible by the benchmark social practices which are Physical, sporting and artistic activities adapted and diversified for a school sports practice (Hébert, 2018: 47 - 48). Moreover, these activities mobilize physiological, cognitive and emotional resources and make it possible to develop the skills specific to PES :achieving maximum motor performance, measurable by a given deadline, moving around by adapting to varied and uncertain movements, perform a body performance for artistic or acrobatic purposes, conduct and master an individual or collective confrontation, carry out and orient your physical activity for self-maintenance (Ewamela, 2005: 13). Performing a physical performance with an artistic or acrobatic aim is a skill developed during the learning of dance and gymnastics.

Gymnastics requires a classification of the gymnastic elements according to the difficulty (A, B, C). The elements of difficulty C have a high rating (3-6 points). Among these elements is the angel jumping. Thus, learning angel jumping requires methodological and social skills, defining both knowledge and reference points in order to appreciate what is really known about knowledge, aptitude and relative abilities, for example : to engage lucidly in practice, to assume different roles, to use different areas to learn. In addition, psychomotor skills (rhythm, spatial organization and coordination) are necessary for learning angel jumping. Indeed, coordination is the mastery of the body's redundant degrees of freedom (at the joint and muscle level) to make it a controllable system (Ganière and Cizeron, 2015: 68). Thus, coordination, strength, strength-velocity, and other physical qualities can be improved during gymnastics in general and angel jumping in particular. The only condition is that it is set up for motor development. The parametrization of coordination allows the adaptation of the general motor programme (PMG) to the specificities of the

motor task by respecting the rules that are revealed by the measurement of absolute time (Thibaud, 2012: 4). It is in this context that we proposed the following study: Effects of environmental context management and parameterization of angel skipping learning on the motor development of students at the EPLUMUMBA high school in Brazzaville (Congo).

Theoretical framework: This work is part of the ecological and dynamic approaches to motor learning. The ecological approach is a theory of perception-action (Cornus and Marsault, 2003: 15). These authors added that it is about optimizing the perceptual process and that learning is a state of attention education. According to this approach, the subject perceives what the environment allows him or her to do, taking into account his or her own physical and motor abilities, depending on his or her age, size, and level of expertise during learning. This requires the adaptation of the gesture coupling the variability of the environment with the subject's perception during the action. As a result, appropriate behaviour emerges from the interaction between the organism (the subject with his or her own capacity for action), the environment (the context in which the action takes place) and the task (the action that the subject must perform) (Lenzen and Reylé, 2017: 57). Fadi and Reynaud (2014: 11) have noted that learning requires intellectual and emotional freedom to better understand and differentiate the learner-subject interacting with the complex environment. The dynamic approach focuses on the evolution over time of the behaviour of complex systems that are sets composed of multiple interacting elements (Delignières and al., 2006: 5). These approaches are complementary and provide an understanding of the development of physical qualities and psychomotor skills during the learning of school-based sport physical activities.

Problematic: Movement coordination in the performance of the act results from the relationships between independent systems: subject-environment, inter-segmental (arm-leg), inter-articular (shoulder-elbow-wrist), interactions (run-jumping an obstacle, coinciding one's trajectory with an object) (Potdevin and al., 2006: 197). The teacher's role is then to manipulate constraints of various kinds, while the student must set up new coordinations, first unconsciously and then voluntarily. Indeed, learning is linked to the constraint of the coordination system. Faced with this, the teacher must draw inspiration without refraining from doing so, shed light on problems, and optimize learning through speed, consistency and sustainability in the light of immediate or distant challenges. This leads to variability in order to motivate pupils (Bressoux, 2012: 214-216). In order to characterize complex coordinations, the tool of dynamic theories must be used in conjunction with the theories of phases and anti-phases according to preferential modes (Temprado, 2004: 46). This author indicated that coordinations are said to be in phase when the different components to be coordinated oscillate simultaneously in the same direction and appear as easily as possible. The evolution of coordinations during learning results from adaptation to a network of constraints. Delignières and al. (op. cit. :10) showed how the subject began to exploit his initial co-ordinations, often successfully in the face of the constraints of the task, in order to prepare the second phase of learning during which this initial solution will be exploited in alternation with another coordination more suited to the task. This is a progressive realisation of the motor tasks specific to the learning of a gymnastic element that translates the parametrization. However, little is known about the parameterization of the

learning of angel jumping in an environment set up for safe ends in high school, even though this gymnastics component is the subject of terminal measurement and evaluation (INRAP, 2000). This is a fundamental concern and leads us to ask ourselves the following questions: What are the effects of environmental planning and the parameterization of the learning of angel jumping on the motor development of the students of the E P LUMUMBA high school in Brazzaville (Congo)?

Hypothesis: To respond to this fundamental concern, we hypothesized that the parameterization of angel jumping learning in a safe and secure environment improves lower limb strength, upper limb strength and overall dynamic coordination of students at the E P LUMUMBA high school in Brazzaville (Congo).

Objectives: In carrying out this study, we set ourselves the following objectives:

- To measure the anthropometric characteristics, physical and psychomotor qualities of the students of the E P LUMUMBA high school in Brazzaville (Congo);
- To evaluate the development of physical and psychomotor qualities during the learning of angel jumping in a safe and secure environment among the students of the E P LUMUMBA high school in Brazzaville (Congo).

MATERIALS AND METHODS

Methodological approach: The study is both experimental and quantitative. It consisted of measuring anthropometric characteristics prior to learning, the evaluation of physical qualities and psychomotor ability through pre and post-training tests of angel jumping in a safe environment. Specifically, this study focused on the measurement of body size and mass on the one hand, and tests to assess upper limb strength, lower limb strength/speed and general dynamic coordination on the other.

Participants: This study involved 32 students in the second year whose gymnastics learning requires the elements of difficulty C, noted on 4 points, in particular the angel jump. They were selected according to the non-probabilistic method and the following criteria: regularity in the PE classes, participation in the different tests of the learning unit.

Setting: The practicable was used for diagnostic and summative evaluations on the one hand and simple didactic regulations on the other. In addition to the walkway, a 6 m long, 3.6 m wide, 0.60 m thick foam made by gluing the foam sub-pieces together, the springboard and the runway 12 m long and 1.22 m wide were used as teaching material adapted to reduce the risk of trauma, to give the pupils confidence and to make the practice of gymnastics more attractive and, above all, safer.

Pedagogical organization: In order to make Angel jumping accessible to all students, numerous possibilities for the arrangement of material situations have allowed a differentiated approach for all class levels. Thus, when facing the flight, the apprehensions of the pupils (and the teacher...) are reduced to a minimum and could concentrate more on the

optimization of: the link élan/pre-call/pulse/flight, the extension/movement/rotation/lifting. These conditional elements of the angel jump have been prescribed to the students in a learning continuum of 56 lessons, 9 for the run-up, 10 for the link run-up-pulse, 9 for the transformation of the run-up into flight-extension, 9 for the piloting of the body in space, 9 for the roll up, 10 for the control of the landing on the foam.

Data collection: The study consisted of three components: anthropometric measurements, physical fitness assessment and psychomotor assessment. Anthropometric characteristics including height and body mass were measured according to WHO recommendations (Malatesta, 2013: 10-12). Physical fitness was assessed from upper limb strength (FMS) and lower limb strength/speed (ΔV) using the Weighing Pressure and Sargent's tests, respectively (Entsiroand al., 2016: 42). The psychomotor assessment concerned general dynamic coordination (GDC) using Chazzo's battery of tests (Lembe, 2013: 98).

Data analysis: The data collected was entered using Microsoft Excel and transferred to SPSS version 22. Normality was verified by Kolmogorov Smirnov's test. As the participants were subjected to two repeated measurements, the pre- and post-learning means were compared using the paired student.

RESULTS

For the characterization of the values of each statistical series, we wanted to present: anthropometric characteristics, physical and psychomotor qualities

Anthropometric characteristics: The age, height, body mass and body mass index of the subjects who participated in the Angel Jumping Learning Study were presented in Table 1 as mean and standard deviation ($\bar{x} \pm \delta$). The analysis in Table I shows that girls were significantly older than boys ($p < 0.001$). In contrast, boys had significantly higher values compared to girls for: height, body mass and BMI ($p < 0.001$).

Table 1: Age, height, body mass and body mass index (BMI) of girls and boys subjected to angel jumping training as mean and standard deviation ($\bar{x} \pm \delta$).

	Girls	Boys	Significance	
	(n = 18)	(n = 14)	T	p
Age (years)	15.94±0.80***	14.93±0.27	5	<0,001
height (cm)	167.00±0.03	178.79±0.89***	47.11	<0,001
Body mass (kg)	64.28±2.65	78.21±0.70***	21.36	<0,001
BMI (kg.m ⁻²)	22.87±0.37	24.47±0.35***	12.75	<0,001

***: Highly significant difference ($p < 0.001$)

Table 2. Lower limb strength (ΔV), upper limb strength (FMS) and general dynamic coordination (GDC) of girls and boys during angel jumping learning as mean and standard deviation Learning the angel jump

	Learning the angel jump		Significance	
	Meadow	Post	t	P
Girls	(n = 18)	(n = 18)		
ΔV (m)	0.27±0.01	0.37±0.01***	30	<0.001
FMS (kg)	22.11±0.90	32.11±0.90***	16.67	<0.001
CDG	5.44±0.51	7.00±1.03***	5.76	<0.001
Boys	(n=14)	(n=14)		
ΔV (m)	0.37±0.01	0.51±0.01***	3,04	<0.001
FMS (kg)	34.07±0.92	39.00±0.88***	14.49	<0.001
CDG	7.43±0.51	9.21±0.89***	6.49	<0.001

***: Highly significant difference ($p < 0.001$)

Physical and psychomotor qualities: Table 1 also presents, as a mean and standard deviation, the lower limb strength (ΔV), upper limb strength (FMS) and general dynamic coordination (GDC) of girls and boys during learning. Table 2 shows that the post-learning values of ΔV , FMS and GDC were significantly higher than those recorded before learning for both girls and boys ($p < 0.001$).

DISCUSSION

The aim of this study was to assess the effects of environmental context management and parameterization of angel jump learning on the motor development of students at the E P LUMUMBA high school in Brazzaville (Congo). At the beginning of this study, we hypothesized that the parametrization of angel jumping learning in an arranged and secure environment taking into account cognitive constraints such as the goal of the task, biomechanical constraints to make the right behaviour and the right feeling come alive, favours the improvement of lower limb strength/speed, upper limb strength and general dynamic coordination. To this end, the experimental and quantitative study was carried out by measuring anthropometric characteristics before learning, tests to evaluate upper limb strength, lower limb strength and speed, and general dynamic coordination before and after learning the angel jump in an environment designed for safety purposes. As the measurements and tests are validated instruments in Physical Activity and Sports Science and Technology, the results obtained are of considerable interest. Motor learning is determined by several factors including anthropometric characteristics. The results of this study show that girls are significantly older than boys (15.94±0.80 years Vs 14.93±0.27 years; $p < 0.001$) (Table 1). The higher age of girls is dependent on the effects of pubertal disruption on schooling. Indeed, girls entering this period of crisis-related morphological, physiological and psychological changes before boys are more oriented towards primary needs to the detriment of commitment to school learning (Ladouceur, 2016: 36). However, boys show significantly higher values compared to girls for height (178.79±0.89 cm Vs 167.00±0.03 cm; $p < 0.001$), body mass (78.21±0.70 kg Vs 64.28±2.65 kg; $p < 0.001$) and BMI (24.47±0.35 kg.m⁻² Vs 22.87±0.37 kg.m⁻²; $p < 0.001$) (Table 1). The larger height of boys is dependent on the onset of peak growth (Bouhours-Nouet et al., 2015: 61). The high values of body mass and BMI in boys are attributable to the development of muscle mass from puberty onwards (Cazorla, 2015: 4). However, these values show that these girls and boys have a significantly higher height and body mass than their Swiss counterparts reported by Braegger et al. (2012 : 21). They do not show any problems with staturoperal growth.

The practice of Physical, Sports and Artistic Activities requires physical and psychomotor qualities. The results of the present study show that post-learning values are significantly higher than those recorded before learning for both girls and boys with respect to ΔV (0.37±0.01cm Vs 0.27±0.01cm and 0.51±0.01 Vs 0.37±0.01 cm; $p < 0.001$) (Table 2). The ΔV significantly higher post learning is dependent on learning the angel jump, of which some learning situations were high forward roll, forward roll before diving, relaxation on the springboard and warm-up plyometric exercises such as backflips, multi-bonds, squats that generated force (Chabloy, 2016:4) and improved the speed of muscle contraction (Guevel and al., 2015:22). Both girls and boys had significantly higher

post-learning FMS compared to their pre-learning FMS (32.11 ± 0.90 kg Vs 22.11 ± 0.90 kg and 39.00 ± 0.88 kg Vs 34.07 ± 0.92 kg; $p < 0.001$) (Table 2). Significantly higher post-learning FMS are related to the angel jump learning situations, including: the transformation of the run-up into fly-extension, body piloting, counter roll during which the arms act as a balancer. The angel jumping learning situations have undeniably led to the development of the FMS. The post-training CDG of angel jumping is significantly different from that obtained before training in both girls (7.00 ± 1.03 Vs 5.44 ± 0.51 ; $p < 0.001$) and boys (9.21 ± 0.89 Vs 7.43 ± 0.51 ; $p < 0.001$) (Table 2). This difference reflects the students' confrontation with a new task that constitutes a complex system prompting the adoption of new behaviours by the students, with the beginner's behaviour being understood as attracting the intrinsic dynamics of this system (Delignières, 2004 :4). This greater post-learning coordination depends on the appearance of new attractors during learning (Delignières et al., 2009: 331). This transition takes place through an alternation phase where the two behaviours are used alternately and allows the subject to stabilise the beginner behaviour.

Conclusion

This study has shown that space planning and parameterization of the teaching/learning of angel jumping induced an improvement in lower limb strength/velocity, upper limb strength and general dynamic coordination in students at the EP LUMUBA high school in Brazzaville (Congo). These results indicate that the spatial layout and the parameterization of the teaching/learning of angel jumping promote the motor development of the students of this high school.

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Data availability: To clarify the conclusion of this study, the data are available from the corresponding author.

Conflicts of interest: The authors state that there is no conflict of interest regarding this article.

Ethical consideration: This project has been approved by the Ethics Council of the Higher Institute of Physical and Sport Education (Marien Ngouabi University). Information about the study was provided in writing to each parent of the participant prior to data collection. All participants gave their informed consent.

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