Biomechanical analysis of the (Tours Chainès) skill in Ballet

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Abstract:

The study aimed to analyze the biomechanical skill of the (Tours Chainès) in ballet, through the descriptive approach by means of kinetic analysis using the Motion Track program, due to its suitability to the nature of the research. The sample for kinetic analysis was chosen intentionally, and it was a free ballet student in the fifth year at the Higher Institute of Ballet at the Academy of Arts and a ballet dancer at the Egyptian Opera House, The sample was subjected to photography and kinetic analysis in the kinetic expression hall at the Faculty of Sports Sciences for Girls - Zamalek - Helwan University, A number of attempts to perform the skill were photographed for the research sample, with the best (3) attempts, The results showed that, the pre-biomechanical analysis of the Tours Chainès skill allowed the researcher to identify the most important body parts associated with the skill and to know the strengths and weaknesses of the students during performance, in addition to the displacement, speed, center of gravity, head, arms, and enhancing the technical level. The trainers can refer toThese results when designing training programs for dancers.

Keywords: (Tours Chainès) - Ballet - turn - Biomechanical Analysis.

التحليل البيوميكانيكي لمهارة دوران السلسلة (Tours Chainès) في الباليه

الملخص:

استهدفت الدراسة التحليل البيوميكانيكي لمهارة دوران السلسلة (Tours Chainès) في الباليه، وذلك من خلال المنهج الوصفي عن طريقة التحليل الحركي بأستخدام برنامج Motion Track وذلك لملائمته لطبيعة البحث، وتم أختيار عينة التحليل الحركي بالطريقة العمدية و هي طالبة باليه حر بالسنة الخامسة بالمعهد العالي للباليه بأكاديمية الفنون وراقصة باليه بدار الأوبرا المصرية ، وتم اخضاع العينة للتصوير والتحليلي الحركي بصالة التعبير الحركي بكلية علوم الرياضة للبنات- بالزمالك-جامعة حلوان ، تم تصوير عدد من محاولات أداء المهارة لعينة البحث لأخيار أفضل (3) محاولات، وأظهرت الذتائج إن التحليل البيوميكانيكي القبلي لمهارة دوران السلسلة (Tours Chainès) اتاح للباحثة التعرف علي أهم أجزاء الجسم المرتبطة بالمهارة و معرفة نقاط القوة و الضعف لدي الطالبات اثناء الأداء بالأضافة إلي الازاحة والسرعة (مركز ثقل الجسم-الرأس –الذراعين) وتعزيز المستوى الفني يمكن للمدربين الرجوع إلى هذه الذتائج عند تصميم برامج تدريب للراقصين.

الكلمات المفتاحية: (Tours Chainès) الباليه - الدوران - التحليل البوميكانيكي.

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Introduction and problem Search

The scientific and technological revolution in all areas of life has become a feature of the twenty-first century, and it has become imperative for us to follow the scientific method as a basis for further advancement and progress so that we can keep pace with the train of civilization in various branches of science and knowledge, Physical education and sports play an important role in the lives of peoples as one of the areas of general education, Until the rise in the level of physical education and sports in any country in the world has become one of the indicators that indicate the extent of its civilizational progress, and scientific progress in training methods and the number of players is one of the aspects on which tangible sports progress is based, as it is considered the final result of benefiting from all other sciences, It has become clear that effective work in the field of training depends on using technical movements and the optimal rhythm that gives the highest difficulty in the connected movements, and that the stages indicating development are determined by knowing the laws of movement, and these laws and their applications cannot be achieved without research and scientific references in the fields of various sports activities that give the ability to show, develop and enhance human

potential in all fields, Scientists and researchers have relied on some modern sciences to solve these motor problems related to the motor performance of players in the field of sports activity, such as the science of Biomechanics for optimal performance.(elqurmady,(2015 AD), p9)

The kinetic analysis is based mainly onIThe laws and principles used in biomechanics are used to study and analyze movement anatomically and mechanically, The word analysis represents, ANALYSIS is a key to defining human movement behavior or path, i.e., the process of dividing the whole ,to Parts in order to study the nature of those parts and the relationship between them by knowing the details of the movement path, and the extent of the relationship between the variables that affect that path, i.e., transforming the phenomenon being studied to Numbers and degrees.(Elmorsy,(2017), p. 13),And The level of motor performance depends on The individual's ability toIIts capabilities will be exploited to determine the skill objectives according to its motor structure, as developed countries have been able to reach the optimal use,For exercises as they represent direct numbers to develop the dancer’s capabilities to raise the level of artistic performance(barqel;aql,(2014AD),p110),and this en trance Motion analysis to identify Errors and shortcomings that occur Performance building for the purpose of improving and developing performance and providing modern training methods and tools based on Real performance information, To get Such data and information are collected through the measurement process, some of which is measured directly, i.e. we obtain to Some of them are directly digitally collected, such as platforms for measuring muscle strength and electrical activity, and other similar devices, and some of them are collected indirectly, such as imaging and then analysis, Data extraction and interpretation. (Hassam El Din,(1994 AD), p. 11)

Ballet is considered one of the branches of Dance, Global Girls Sports Activities it is characterized by an aesthetic artistic character that requires efficiency, High In performance and speed of response to different musical rhythms. (Fletcher & others, (1959),P22),and Which is taught in the curricula of the colleges of physical education for girls, counting The advancement of ancient theatrical arts that have evolved with different eras and civilizations, as well as modern training systems and technology, And

the old one Limit activities Sports knew the success of Al-Tahami (2002) the ballet The art of the massesto (Beauty of movement, beauty of formation, beauty of precision in performance), It shows the music of movement, the grace of performance, and the sweetness of the step Ballet is considered a new and modern art, while dancing is, Science as old as man and his existence. (tahami,(2002 AD, p. 25), By analyzing the nature and requirements of the skill And tours is a complex harmonic movement that requires a high degree of control over body parts, whether before or after. During or after the movement, in tours the student needs to quickly transfer the weight of the body on Fingers The feet are straight, the arms are tightly joined, and the free leg is joined to the supporting foot, All of this is accompanied by a turn of the body to change direction with the help of the head movement and fixing the gaze on a specific point to return to it after the turn, which requires a quick change in the body position and adjusting the performance with the connection between the parts of the movement and the component, Here, Also, standing on the ball of one foot requires control over Muscular and nervous systems of the body to help Amanita Body position without losing balance when turning Same place or move, also turn requires a great deal of sense of place, dimensions and movement over a narrow fulcrum.(Noureldein.(1985 AD):p32)

And through The researcher went up to Many scientific references and Arab and foreign studies have found that there is a lack of research on It deals with the problems of skill performance of tours, Using scientific foundations through kinetic analysis In the pass-through the researcher's teaching of the subject of kinetic expression at the College of Sports Science girls-In Zamalek noticed that the students find it very difficult to perform the skill, And **(Tours Chainès)** Which Editor many students They finished their college studies without being able to A Spinal disease the right way No Of the difficult motor skills and I Requires a great deal of coordination between the movements of the arms, legs and trunk,A Performance praise in free ballet, and Also among the mandatory skills required for Third year students at the college, as well as No Requires Vertical and horizontal muscle thrust of the lower extremity at disease Skill With extension and lengthening of the legs with a degree of neuromuscular coordination when performing this Skill Which prompted the researcher to

Trying to identify the difficulties Students face A disease Skill Under investigation, and throughOptimal kinematic paths for **(Tours Chainès)** skill Using kinetic analysis of Improve your level A disease.

Research objective

- The research aims to identify Biomechanical analysis of the (Tours Chainès) skill in ballet .

Questions Search

- What are the amounts of variables affecting the skill of the skill in ballet?

Terms Search

Biomechanics: he the science that studies the stillness and relative motion of objects. (elqaurmdy,(2015) AD, p. 12)

Skill: It is the ability to use the correct muscle with the necessary force to perform the movement in the right order and timing. (Helmy**;**Briqa,(1997m),p12

(Tours Chainès): It is a half-turn with each step of one foot behind the other, alternating. (Al-Tihami(2002 AD), p85)

Ballet: It is an integrated art performed with specific movements in a limited space by people trained to a rhythm to express a specific idea or story. (Tihami,(1992 AD),p27

Procedures Search

First: Research Methodology

To achieve the research objective and hypotheses, the researcher used the method Descriptive method of kinetic analysis using the program Motion Track This is due to its suitability to the nature of the research.

Secondly: Research areas

1- Spatial domain:-

- The dance Hall, Faculty of Sports Sciences for Girls zamalk, Helwan University.

The location of the research procedures was chosen for the following reasons:

- Tools and equipment needed to carry out measurements (length-the weight).
- Easy to transport tools and equipment.
- Proximity of the location to the research sample.

2- Time frame:-

- The research was conducted during the year (2022-2023) according to the following: -
- Survey study
  - Ensure that all appropriate tools and equipment are available and in good working order.
  - Ensure the location is suitable for filming.
  - Determine the appropriate scope for filming the performance.
  - Determine the appropriate frequency for filming the performance and where to install the cameras.
- Basic study
  - A number of attempts to perform the skill were filmed for the research sample to choose the best (3) attempts.

3- Research sample Motion

Analysis sample: The sample for the movement analysis was chosen intentionally. It was a free ballet student in the fifth year at the Higher Institute of Ballet at the Academy of Arts and a ballet dancer at the Egyptian Opera House.

Table (1)

Training age	the weight	Height	Age	the name
8 years	48	165	21	Shahed Mohamed Fawzy Abdullah

Fourth: Imaging devices and tools and motion analysis software

Components of the 3D motion analysis program:

- Computer brand (IBM)

2GB memory, 100GB hard drive, SP2

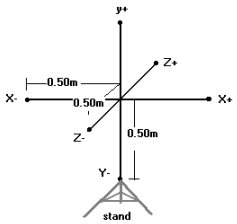
Video camera brandSony + memory 80GB

Image Processing Unitcamera or monitor

-Features of the motion analysis program (Motion Track)

Registered at the Information Systems Center of the Academy of Scientific Research under No. 665/5 dated 5/23/2001 AD, About Dr. Mustafa Atwa, Professor of Biomechanics and Sports Movement Sciences, Faculty of sports science, Sadat City, Sadat City University

- **Calibration unit for the program**



Appearance (1) Calibration unit for the kinetic analysis program (Motion Track)

The program can read any known unit of length in nature visible within the frame.

The calibration system is stored in the computer memory for each camera separately. It is a device with perpendicular dimensions as follows: 0.50m x 0.50m x 0.50m, and its role is to determine distances in nature from the frames.

- Program capability:

The program performs the necessary motor analysis for any motor skill (linear, rotational, compound) and through it we can obtain a number of biomechanical variables for the body as a whole and for each part of the body during each moment of performance and in the directions (x,y,z,xy,zy,zx,zyx) which is represented in (temporal analysis) which contains the temporal distribution for each stage of performance, (chemical analysis) which contains distance, displacement, speed, acceleration, joint angles, and angles of inclination of parts on the horizontal level, angular velocity, angular acceleration, and (kinetic analysis) represented in potential energy, kinetic energy, force, work, power, torque, centrifugal force, momentum, angular momentum, rotational inertia.

Imaging procedures: Attachment (2)

(Tours Chainès) skill is depicted Through the free ballet player (motion analysis sample) on 11/11/2022 AD in the ballet hall at the College of Sports Sciences for Girls-Helwan University, after performing a number of successful attempts at the skill, the best (3) attempts were taken for the purpose of biomechanical analysis to extract the most important variables.

Analysis procedures: of Procedures Analysis

The analysis was conducted during the period from 11/12/2022 to 12/12/2022, and the technical stages of performance were extracted as shown in Attachment (3) and the most important parts of the body for performing the (Tours Chainès) skill **Imaging and storage operations: Storage Process**

Reviewing the imaging processes to send them to the computer that contains the motion analysis program (**Motion Track)**via **USB** After storing the film inside the computer, it is called on the program to determine the period from which the analysis of the attempt will begin and end.

Analysis specifications:

Reference points for the sample during the different performance stages, where the reference points for the body as a whole were chosen, numbering 17 points, which are (the head, the front of the right hand instep, the right wrist, the right elbow, the right shoulder joint, and their counterparts the left arm, the front of the right foot instep, the right wrist, the right knee, the right hip joint, and their counterparts the left leg) in order, and their definition for the model The atwaa model in the program is used to determine the general center of gravity of the body and its parts and the rest of the kinematic and kinetic variables through mathematical treatments, where the general center of gravity is estimated using the relative distribution of the centers of gravity of the parts as well as the relative weight of the parts as a percentage of the total weight of the body, according to James G.Hay (1985 AD) quoted from Clawser.

Fifth: Measuring devices and tools:

1) Rustameter to measure length in centimeters.
2) Medical scale for measuring weight in kilograms.
3) Sample data and measurement registration form. Attachment (1)

Sixth: Statistical methods

Statistical methods were performed using the program spss to extract:-

- 1- Arithmetic mean 2-Standard deviation 3- regression coefficient

An offer and discuss Results:

Table (2)
Time distribution for performing (Tours Chainès) skill

the total	Fifth	Fourth	Third	Second	First lap	Variables
5.33	0.52	0.91	1.43	1,17	1,3	Time (sec)
100%	9.76%	17.07%	26.83%	21.95%	24.39%	ratio

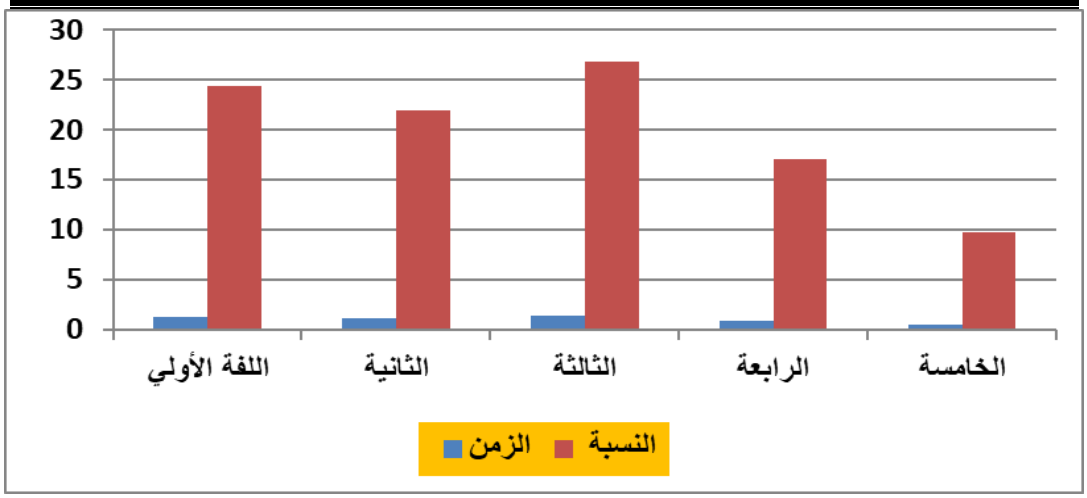


Figure (2) Time distribution of performance

From Table No (2) indicating the time distribution of the fifth lap comparison Movements Rotational between Rolls with levels efficiency Varying It was noted that it when Rotation At an angle180degree The skill took (5.33 seconds) and as he Explained in Figure (1) shows that the first lap took a time of (1.3) seconds, achieving a percentage of (24.39%), while the second lap took (1.17) seconds, achieving a percentage of (21.95%), the third took (1.43) seconds, achieving a percentage of (26.83%), and the fourth took (0.91) seconds, achieving a percentage of (17.07%) And the fifth took (0.52) at a rate of (9.76%). The researcher concludes that when the series Rotating 360 degrees, the fifth lap was the fastest, followed by the fourth lap, then the second, then the first, and finally the third lap. The researcher attributes this to cases of accelerated balance, in addition to

control. In distribution block Body to determine speed Relativity For rotation and different preparation time to start a movement tours.

Table (3)
Actual and theoretical horizontal and vertical displacement and velocity of the center of gravity

Vertical speed		Horizontal speed		Vertical		Horizontal		Tim	The
theoretic	actua	theoretic	actual	theoretic	actua	theoretic	Actua	e	rolls
0.112	0.30	0.028	0.023	0.639	0.60	0.67	0.07	0	
0.106	0.17	0.060	0.100	0.646	0.64	0.67	0.07	0.1	
0.102	0.07	0.041	0.054	0.652	0.62	0.68	0.08	0.2	
0.100	0.05	0.031	0.031	0.6585	0.63	0.67	0.08	0.3	The
0.120	0.47	0.491	1.162	0.665	0.62	0.67	0.07	0.5	roll
0.100	0.04	0.653	1.562	0.672	0.68	0.76	0.22	0.6	The
0.101	0.06	0.025	0.015	0.678	0.69	0.87	0.43	0.7	first
0.102	0.07	0.022	0.008	0.685	0.70	0.87	0.43	0.9	
0.098	0.00	0.338	0.785	0.691	0.69	0.87	0.43	1.0	
0.103	0.11	0.559	1.331	0.698	0.69	0.93	0.53	1.1	
0.100	0.03	0.041	0.054	0.704	0.70	1.03	0.70	1.3	
0.099	0.03	0.022	0.008	0.711	0.71	1.03	0.71	1.4	
0.099	0.02	0.416	0.977	0.717	0.70	1.03	0.71	1.5	
0.107	0.20	0.672	1.608	0.724	0.70	1.11	0.84	1.6	
0.103	0.10	0.031	0.031	0.73	0.72	1.22	1.05	1.8	
0.103	0.10	0.066	0.115	0.737	0.74	1.22	1.04	1.9	Secon
0.128	0.64	0.160	0.346	0.743	0.72	1.23	1.06	2.0	d
0.116	0.39	0.806	1.938	0.75	0.81	1.21	1.01	2.2	
0.103	0.11	0.072	0.131	0.756	0.76	1.35	1.26	2.3	
0.109	0.23	0.085	0.162	0.763	0.74	1.36	1.28	2.4	
0.104	0.12	0.447	1.054	0.769	0.77	1.35	1.26	2.6	
0.106	0.16	0.547	1,300	0.7755	0.76	1.42	1.40	2.7	
0.100	0.03	0.031	0.031	0.782	0.78	1.52	1.57	2.8	
0.102	0.09	0.053	0.085	0.789	0.77	1.52	1.56	2.9	
0.113	0.33	0.769	1.846	0.795	0.76	1.52	1.57	3.1	
0.100	0.04	0.497	1.177	0.8015	0.80	1.66	1.81	3.2	Third
0.105	0.15	0.244	0.554	0.808	0.80	1.75	1.97	3.3	
0.112	0.30	0.528	1.254	0.8145	0.82	1.79	2.04	3.5	
0.102	0.09	0.022	0.008	0.821	0.86	1.88	2.20	3.6	
0.100	0.05	0.266	0.608	0.8275	0.85	1.88	2.20	3.7	
0.111	0.29	0.185	0.408	0.834	0.84	1.92	2.28	3.9	
0.117	0.41	0.478	1.131	0.8405	0.88	1.95	2.33	4.0	
0.111	0.28	0.231	0.523	0.847	0.82	2.04	2.48	4.1	
0.099	0.01	0.363	0.846	0.8535	0.86	2.08	2.55	4.2	
0.190	2,00	8,089	19.87	0.86	0.86	2.14	2.66	4.4	Fourth
0.112	0.30	0.028	0.023	0.639	0.60	0.67	0.07	4.5	
0.106	0.17	0.060	0.100	0.6455	0.64	0.67	0.07	4.6	
0.102	0.07	0.041	0.054	0.652	0.62	0.68	0.08	4.8	
0.100	0.05	0.031	0.031	0.659	0.63	0.67	0.08	4.9	Fifth
0.120	0.47	0.491	1.162	0.665	0.62	0.67	0.07	5.0	

0.100	0.04	0.653	1.562	0.672	0.68	0.76	0.22	5.2	
				0.678	0.69	0.87	0.43	5.3	

According to the table (3) indicating both the horizontal and vertical displacement and linear velocity of the center of gravity of the body, It was found that there was a large difference in the actual horizontal displacement of the center of gravity between the five laps during continuous turn Specifically, the first lap showed an ascending pattern in the displacement of the center of gravity from the first circle to the third circle, where the average of each of them reached (0.29 ± 0.82), (0.99 ± 0.21), (1.81 ± 0.35) respectively, with a large difference between them amounting to (0.7, 0.82) respectively, while the fourth and fifth laps showed a descending pattern, with the average of each of them amounting to (1.47 ± 1.3), (0.20 ± 0.17) with a small difference between the third and fourth laps amounting to (0.34) and the difference increased between the fourth and fifth laps, where it reached (1.27) and that was with a vertical displacement It also varied between the five laps, as the average between them, respectively, from the first to the third, achieved an ascending pattern of (0.66 ± 0.04), (0.74 ± 0.03), (0.81 ± 0.04) with a slight difference between them amounting to (0.08, 0.07), while the fourth and fifth laps achieved a descending pattern amounting to (0.76 ± 0.11), (0.66 ± 0.04) with a difference between them amounting to (0.05), respectively. (0.1) The researcher attributes this to the body gaining torque from the first lap in order to provide an opportunity to use the horizontal reaction force to apply torque around the center of gravity and not extend the foot forward (horizontal axis) by a large distance from the increase in torque. This indicates that this lap showed stronger vertical stability and more accomplished rotational movement, which is consistent with what Catherine Haber indicated (Catherine Haber (2019) Balance predicts best rotational performance.(Haber,Feb 2019)

The researcher finds it interesting that the range of vertical center of gravity movement revealed a downward trend with increasing number of cycles and a difference between the conditions of each cycle. In other words, with increasing number of cycles, skilled dancers tend to suppress the body movement downward and upward while enhancing the rotation of the trunk (shoulder line) and arms in order to generate additional angular momentum The researcher attributes this to the fact that vertical speed does not play

any role in the performance of rotation, but rather horizontal speed has the primary role in achieving this, as the actual displacement converged with the theory, and in addition to that, achieving positional stability in order to achieve kinetic balance during the fifth turns, as it is one of the three important characteristics of rotation, and this is consistent with what Melanie B. Lott and Kenneth L. Laws indicated.Melanie B. Lott and Kenneth L. Laws) (2012) If the cycle is not performed with the body in balance, it is not considered successful.
(B. Lott & L. Laws, 2012, P4) .

Table (4)
Actual and theoretical horizontal and vertical displacement and velocity of the head

Vertical speed		Horizontal speed		Vertical		Horizontal		Time	The rolls
theoretica	actua	theoretica	actua	theoretica	actua	theoretica	Actua		
0.22	0.16	0.75	0.16	1.17	1.11	0.09	0.10	0	
0.21	0.24	0.70	0.90	1.18	1.13	0.02	0.08	0.1	
0.22	0.16	0.76	0	1.19	1.10	0.05	0.03	0.2	
0.22	0.08	0.75	0.08	1.20	1.12	0.13	0.03	0.3	The roll The first
0.21	0.24	0.68	1.23	1.21	1.13	0.20	0.04	0.5	
0.21	0.90	0.67	1.4	1.22	1.16	0.28	0.19	0.6	
0.22	0.08	0.75	0.08	1.23	1.28	0.35	0.37	0.7	
0.22	0.16	0.75	0.16	1.24	1.27	0.42	0.38	0.9	
0.21	0.32	0.72	0.65	1.25	1.29	0.50	0.36	1.0	
0.22	0.08	0.64	1.89	1.26	1.25	0.57	0.44	1.1	
0.22	0	0.76	0	1.27	1.26	0.65	0.68	1.3	
0.22	0	0.75	0.08	1.28	1.26	0.72	0.68	1.4	
0.22	0.16	0.69	1.07	1.29	1.26	0.79	0.67	1.5	
0.21	0.49	0.68	1.23	1.30	1.28	0.87	0.80	1.6	
0.22	0.16	0.76	0	1.31	1.34	0.94	0.96	1.8	Second
0.22	0.08	0.76	0	1.32	1.36	1.01	0.96	1.9	
0.22	0	0.70	0.90	1.33	1.35	1.09	0.96	2.0	
0.21	0.41	0.66	1.48	1.34	1.35	1.16	1.07	2.2	
0.22	0.08	0.75	0.16	1.36	1.30	1.24	1.26	2.3	
0.22	0	0.75	0.16	1.37	1.31	1.31	1.24	2.4	
0.21	0.49	0.71	0.74	1.38	1.31	1.38	1.26	2.6	
0.21	0.49	0.69	1.07	1.39	1.37	1.46	1.35	2.7	
0.22	0	0.74	0.24	1.40	1.43	1.53	1.49	2.8	
0.22	0	0.75	0.08	1.41	1.43	1.61	1.52	2.9	
0.22	0.16	0.61	2.38	1.42	1.43	1.68	1.51	3.1	Third
0.22	0	0.69	1.07	1.43	1.45	1.75	1.81	3.2	
0.21	0.41	0.73	0.41	1.44	1.45	1.83	1.94	3.3	
0.22	0	0.68	1.23	1.45	1.51	1.90	1.99	3.5	
0.22	0	0.76	0	1.46	1.51	1.97	2.15	3.6	
0.22	0.08	0.72	0.57	1.47	1.51	2.05	2.15	3.7	

0.22	0.16	0.71	0.74	1.48	1.52	2.12	2.22	**3.9**	
0.21	0.32	0.69	1.07	1.49	1.5	2.20	2.31	**4.0**	
0.21	0.32	0.72	0.65	1.50	1.54	2.27	2.45	**4.1**	
0.21	0.41	0.72	0.65	1.51	1.58	2.34	2.53	**4.2**	
0.21	0.32	0.74	0.32	1.52	1.63	2.42	2.61	**4.4**	**Fourth**
0.22	0.16	0.67	1.4	1.53	1.59	2.49	2.65	**4.5**	
0.22	0.08	0.74	0.32	1.54	1.61	2.57	2.83	**4.6**	
0.21	0.49	0.71	0.74	1.55	1.60	2.64	2.87	**4.8**	
0.22	0.16	0.73	0.49	1.56	1.66	2.71	2.96	**4.9**	
0.22	0.08	0.74	0.32	1.57	1.64	2.79	3.03	**5.0**	**Fifth**
0.22	0.16	0.75	0.08	1.58	1.65	2.86	3.07	**5.2**	
				1.59	1.67	2.93	3.06	**5.3**	

Table (5)
Mean and standard deviation of horizontal and vertical displacement and velocity of the head

Fifth		Fourth		Third		Second		The first		The rolls
Deviation	middle	deviation	middle	Deviation	Middle	Deviation	middle	Deviation	middle	Variables
0.05	3.03	0.20	2.61	0.35	1.77	0.22	0.96	0.22	0.25	Actual horizontal displacement
0.09	2.82	0.16	2.41	0.25	1.75	0.2	1.01	0.22	0.29	theoretical horizontal displacement
0.01	1.66	0.05	1.58	0.06	1.45	0.04	1.32	0.08	1,19	Actual vertical displacement
0.01	1.58	0.02	1.52	0.03	1.43	0.03	1.32	0.03	1.22	theoretical vertical displacement
0.21	0.30	0.39	0.74	0.67	0.78	0.59	0.57	0.67	0.59	Actual horizontal speed
0.01	0.74	0.03	0.71	0.04	0.71	0.04	0.72	0.04	0.72	theoretical horizontal velocity
0.05	0.14	0.14	0.31	0.21	0.17	0.18	0.16	0.25	0.23	Actual vertical speed
0.00	0.22	0.005	0.21	0.005	0.22	0.004	0.22	0.005	0.23	theoretical vertical velocity

Table (4, 5) indicating the actual and theoretical horizontal and vertical displacement and speed of the head show that there is a difference between the position of the head during the performance of the five actual and theoretical laps, as both the actual and theoretical horizontal displacement of the first lap appeared to increase at an average rate, respectively, of (0.25±0.22), (0.29±0.22) with a very small difference of (0.04)±0) & in the second it increased at a large average rate of (0.96±0.21), (1.01±0.20) with a slight difference of (0.05)±0.01) and a large, almost equal difference from the actual and theoretical first, as the

difference between them reached, respectively, (0.7±0), (0.72±0.01) & during the third it continued to rise, reaching an actual average of (1.77±0.35) and the theoretical is less than that (1.75).±0.25) but at a low rate of (0.2)±0.02) and the difference in height between it and the second lap in order was (0.81).±0.14) In the fourth, the actual increase continued, as the average rate reached (2.61).±0.2), while the the recital one was less than that and reached (2.4).±0.16) and the difference between them is (0.21).±0.04) but the difference between it and the third in order was (0.81) and with a smaller deviation of (±0.15), (1.39±0.09) and continued to rise during the fifth lap, but at a high rate relative to the actual rate, reaching (3.03).±0.05) and the difference between it and the fourth was (0.42).±0.15) and also for the theory, where its average was (2.8).±0.16) an increase of 0.4 over the fourth.±0.0) While the actual and the recital vertical displacement was observed to fluctuate between increase and decrease, reaching, for the first lap, respectively, (1.19±0.08), (1.22±0.03) with a slight difference between them of (0.03)±0.05) & During the second round, the researcher found a similarity between the actual and theoretical, as they reached (1.32).±0.04, 0.03) and a difference of 0.13 from the first, respectively.±0.04), (0.1±0.0) As for the third, the increase continued, reaching (1.45) in order.±0.06), (1.43±0.03) with a very small difference between them of (0.02).±0.03) and with an increase of one second, it reached (0.13) respectively.±0.02), (0.11±0.0) During the fourth lap, there was also an increase in the actual and theoretical vertical displacement amounts compared to the third lap, reaching (1.58±0.05), (1.52±0.02) and in the same order with a difference of (0.13±0.01), (0.09±0.01) and a difference of (0.06) between them.±0.03), as they came with very small differences between the first and second, which amounted to (0.07).±0.07) and between the second and third, which amounted to (0.01).±0.03) and between the third and fourth, it reached (0.14).±0.07) and between the fourth and fifth and reached (0.17±0.09) The researcher attributes this to maintaining vertical alignment. With the earth during phase Preparation is important as most of the angular momentum of the rotation is generated in it. Which He provides Basically Durable to rotate the next is where the head rotates without tilting, i.e. in a straight horizontal line, in order to achieve rhythm. Expected in situation stable relatively And achieve behavior Typically to look at It is called to set The goal and the researcher

believes that this leads to accuracy And the quality of rotation as the focus attention Individual He plays role Basically in How to performance Courses Ballet and therefore dancers determine goal In front of them And they keep on concentration Their view We also depend on him on Signals Outgoing from Our bodies Animated until We can from Response For space Surrounding We built And the response quickly For the circumstances Variable.

Table (6)

Actual and theoretical horizontal and vertical displacement and velocity of the trunk

Vertical speed		Horizontal speed		Vertical		Horizontal		Time	The rolls
theoretical	actual	theoretical	Actual	theoretical	actual	theoretical	actual		
0.26	0.148	0.86	0.082	0.802	0.741	0.13	0.084	0	The roll The first
0.27	0.066	0.78	1.062	0.803	0.759	0.14	0.073	0.13	
0.27	0.099	0.86	0.107	0.802	0.751	0.15	0.06	0.26	
0.27	0.091	0.86	0.066	0.803	0.763	0.16	0.047	0.39	
0.26	0.667	0.76	1.375	0.802	0.752	0.16	0.038	0.52	
0.26	0.206	0.74	1.605	0.808	0.836	0.05	0.211	0.65	
0.26	0.288	0.86	0.074	0.806	0.81	0.07	0.413	0.78	
0.26	0.156	0.86	0.049	0.809	0.846	0.07	0.403	0.91	
0.27	0.016	0.79	0.988	0.807	0.826	0.07	0.41	1.04	
0.27	0.091	0.77	1.227	0.808	0.829	0.15	0.534	1.17	
0.27	0.099	0.86	0.074	0.808	0.84	0.24	0.688	1.3	
0.27	0.091	0.87	0.033	0.809	0.852	0.25	0.697	1.43	Second
0.27	0.082	0.79	0.914	0.808	0.841	0.25	0.701	1.56	
0.26	0.181	0.73	1.762	0.809	0.851	0.32	0.816	1.69	
0.27	0.074	0.87	0.016	0.811	0.874	0.46	1.037	1.82	
0.27	0.074	0.86	0.14	0.811	0.883	0.46	1.035	1.95	
0.25	1.811	0.74	1.589	0.811	0.874	0.47	1.053	2.08	
0.25	1.54	0.61	3.186	0.826	1.102	0.35	0.853	2.21	
0.26	0.132	0.86	0.107	0.813	0.908	0.59	1.254	2.34	
0.27	0.033	0.87	0.008	0.812	0.892	0.60	1.267	2.47	
0.26	0.14	0.81	0.683	0.812	0.896	0.60	1.268	2.6	Third
0.26	0.231	0.74	1.63	0.813	0.913	0.66	1.354	2.73	
0.27	0.099	0.87	0.008	0.815	0.942	0.78	1.559	2.86	
0.27	0.033	0.86	0.082	0.814	0.93	0.79	1.56	2.99	
0.26	0.362	0.72	1.803	0.814	0.926	0.79	1.57	3.12	
0.27	0.049	0.79	1.021	0.817	0.971	0.93	1.797	3.25	
0.27	0.091	0.80	0.848	0.817	0.965	1.01	1.925	3.38	
0.26	0.412	0.77	1.227	0.817	0.976	1.08	2.032	3.51	
0.27	0.074	0.87	0.016	0.821	1.028	1.17	2.186	3.64	
0.26	0.296	0.84	0.387	0.820	1.019	1.17	2.184	3.77	
0.26	0.486	0.83	0.494	0.818	0.982	1.20	2.232	3.9	
0.26	0.453	0.77	1.268	0.822	1.043	1.24	2.294	4.03	Fourth
0.26	0.338	0.83	0.445	0.818	0.986	1.34	2.454	4.16	

0.27	0.041	0.78	1.087	0.821	1.028	1.38	2.509	4.29	
0.26	0.14	0.80	0.856	0.821	1.033	1.46	2.646	4.42	
0.26	0.428	0.82	0.576	0.822	1.051	1.53	2.754	4.55	
0.27	0	0.83	0.445	0.826	1.105	1.57	2.826	4.68	
0.27	0.091	0.82	0.543	0.826	1.105	1.61	2.882	4.81	
0.26	0.132	0.80	0.864	0.825	1.093	1.65	2.95	4.94	Fifth
0.27	0.066	0.85	0.165	0.826	1.11	1.72	3.059	5.07	
0.27	0.058	0.86	0.058	0.826	1.102	1.73	3.079	5.2	
0.27	0.049	0.86	0.091	0.825	1.094	1.74	3.087	5.33	

Table (7)
Mean and standard deviation of the horizontal and vertical displacement and velocity of the trunk

Fifth		Fourth		Third		Second		The first		The rolls / Variables
Deviation	middle	deviation	middle	Deviation	Middle	deviation	middle	deviation	middle	
0.06	3.04	0.21	2.62	0.35	1.79	0.22	0.97	0.23	0.27	Actual horizontal displacement
0.04	1.71	0.13	1.45	0.22	0.93	0.13	0.42	0.06	0.13	theoretical horizontal displacement
0.01	1.9	0.04	1.05	0.04	0.96	0.08	0.89	0.42	0.79	Actual vertical displacement
0.003	0.83	0.003	0.82	0.003	0.82	0.01	0.81	0.03	0.81	theoretical vertical displacement
0.38	0.29	0.33	0.75	0.63	0.75	1,12	0.86	0.63	0.61	Actual horizontal speed
0.03	0.84	0.02	0.81	0.05	0.81	0.09	0.8	0.05	0.81	theoretical horizontal velocity
0.04	0.08	0.19	0.21	0.16	0.21	0.7	0.45	0.18	0.18	Actual vertical speed
0.01	0.27	0.01	0.26	0.01	0.27	0.01	0.26	0.01	0.27	theoretical vertical

It is clear from tables (6, 7) indicating both the actual and theoretical horizontal and vertical displacement and speed of the trunk that despite the increase in the horizontal displacement curve of the trunk during the five turns, the researcher sees a difference between the decrease and the increase during the intermediate displacements. She has deduced this from the amounts of dispersion (standard deviation) occurring in each turn, where during the first turn there was a decrease until its middle, then it increased and its average reached (0.27).±0.22), and during the second lap the average increased and reached (0.97).±0.22) a large difference from the first, which amounted to (0.7±0.00), and in the third the average was (1.79±0.35) with an increase in the difference from the second and reached (0.82±0.13), and during the fourth it reached (2.62±0.21) with an increase in the average over the third by a difference of (0.83) and less in the deviation in which the difference reached (±0.14) The average increased significantly during the fifth lap compared to the fourth, reaching (3.04).±0.06) with a difference of (0.42)±0.15) While the opposite is clear for the theoretical horizontal displacement, as it began in the first lap with an increase in the intermediate displacement at simple rates, then decreased and increased, and the disparity between the decrease and increase continued until the end of the fifth lap at rates lower than the actual, as the average dispersion for each of them reached amounts of (0.13, respectively).±0.06), (0.42±0.13), (0.96±0.04) (1.05±0.04), (1.9±0.01) and the differences reached respectively (0.14±0.16), (0.55±0.09), 0.86±0.13), (1.17±0.08), (1.33±0.02) The researcher attributes this to the performance requirements that include acquiring an appropriate horizontal distance during the preparation phase in order to further enhance Control The stable in The body where harmony is with place The basin maybe that He is a point beginning Good To rotate, based on what Catherine mentioned. Haber (2019)**Catherine Haber)**That deviation The basin Related Related Closely With deviation center The mass also shows that the actual horizontal velocity of the trunk varied in value between high and low during the five turns, where the average and dispersion of each reached (0.61, respectively).±0.63), (0.86±1.12) with a difference of (0.23) over the first.±0.49), (0.75±0.33) with a decrease of (0.11) per second.±0.49), (0.75±0.33) without average difference but with less dispersion (±0.3), (0.29±0.38) a significant decrease from the fourth (0.46)±0.05) While we

find a close convergence between the theoretical horizontal speed, as the differences between them were very simple, which began with a decrease between the first and second, reaching(0.01.±0.04), and an increase between the second and third, reaching (0.01±0.04) and equal between the third and fourth, but with a deviation of (±0.03) and it came with an increase in the fifth over the fourth amounting to (0.03)±0.01) and differences between it and the actual, as it reached an increase in the first lap of (0.2) and a smaller deviation of (±0.58) and decreased during the second and reached (0.06).±1.03) Then it started to increase from the third to the fifth, where the increase reached (0.06) respectively.±0.58), (0.06±0.31), (0.55±0.35) The researcher attributes this to the fact that it is usually what It starts generation Momentum The angular With movement torsion(He wrapped)For the trunk The upper one with regards For the basin And it begins a movement trunk In a way block As a unit one when Come back line Shoulder to Alignment Parallel For line thigh during Rotation in direction Scorpions The clock, as this part is of great importance for the success of the turn.

Conclusions and recommendations

Firstly: **Conclusions**

In light of the goalAnd questionsResearch procedures and resultsWithin the limits of the selected research sampleThe researcher reached the following conclusions:

1- Pre-skill biomechanical analysis (Tours Chainès) it enabled the researcher to identify the most important parts of the body related to the skill and to know the strengths and weaknesses of the students during performance, which helped to develop a set of appropriate educational exercises to meet the weaknesses and raise the skill level.

Second: **Recommendations**

Within the limits of the results and conclusions reached, the researcher recommends the following:

1- She was there Kinematic variations in both displacement and velocity for all body parts selected for research and enhancement Level Technical maybe for trainers Back to This is amazing Results when

design Programs training for dancers and it must On them the focus on strengthening group Muscles Basic And enhance power trunk To improve Control on The body.

2- The researcher recommends conducting this research with expansion of biomechanical variables for a deeper understanding of performance, such as calculating ground reactions and related pushes and other.

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