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Evaluation of Hammer Throw Technique for Faculty of Physical Education Students using DartFish Technology

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Abstract

Hammer throw Competition is considered one of the most complex throwing Competitions in terms of performance technique and the learning difficulties, therefor using the latest methods and technological means and all possible effectors is required during the learning process. This study aims to evaluate of Hammer Throw Technique for Faculty of Physical Education Students using DartFish Technology. The researcher used the experimental method on a sample of 45 students. They were divided into two groups, a control group which consisted of 25 students who used the traditional program in learning the hammer throw, while the other one is the experimental group which consisted of 20 students who learned the hammer throw by evaluation Technique using DartFish Software Team Pro 4 through three cameras (60 Frame/sec). Finally the results showed that the proposed learning program using DartFish to evaluate the Technique, improved the Technique and distance by developing the single and double support phases times, turn velocity and release in the hammer throw Competition for the students of the Faculty of Physical Education for Boys, Alexandria University.

Keywords: *Hammer Throw Competition, DartFish application, Technique Evaluation*

Introduction

The Hammer throw is one of the complex Competitions due to its Technique, which requires utilizing the forces of various parts in the body and movements harmony. The main aim of which is to throw the hammer away as far as possible without infracting the rules of the Competition. The main aim of which is to throw hammer away as far as possible without infracting the rules of the Competition. The right technique depends on reaching the maximum velocity with the hammer at releasing. The movement begins with preliminary swings followed by three or four turns, where the player turns with the hammer in synchronized manner. While swinging and turns the hammer's speed increases gradually until releasing. (22:228), (23:127), (2:69)

The Hammer throw Competition is considered one of the most complex throwing Competitions in terms of technique and the learning difficulty. (21:56) as it requires compatibility of body mass with the tensile strength resulting from the turns, so the coaches have to take their time in teaching by dividing the Competition components into separate parts to practice each of them separately preparing to perform them again combined as one unit, and then divided once again periodically. (9:4113) (24:71) the player's success is noticed during the various trainings and educational exercises from the beginning of learning until reaching the high levels. (15:111)

The researcher noticed the lack of hammer throw players in most of the clubs of Alexandria Governorate, Egypt, because of the difficulty of this Competition and the lack of suitable fields for the game. Although the hammer throw Competition is taught to the students of the Faculty of Physical Education for Boys, Alexandria University, the Technique and distance are very weak compared to the other throwing Competitions. The researcher made Exploratory Study on 295 of the second grade students of the academic year 2014/2015, in order to identify the hammer throw distance. The results concluded the distance 16.522 ± 4.026 meters. The most notable reason for the weak of distance of those students is great learning difficulty in the hammer throw, and that led to the low Technique and distance.

Therefore, the researcher proposed an educational program depends on evaluating the Technique phases during teaching the hammer throw Competition using DartFish application, as it is considered the most modern application of analyzing Technique. It is an effective and integrated application for analyzing videos using the tools and features that enable direct analysis and evaluation of

the performance through the teaching and training phases and during the sports competitions. (8)

Technique preparation is the main factor for enhancing of the performance level by teaching and developing the performance method which appears through the optimal performance of the technique, so the coaches had to improve the technique by using the latest methods and ways that improve the level. (5:418)

Education is more effective when more senses are used in the educational process. This explains the increased interest in using the learning Instruments in learning the motor skills. (17:163) therefore it is important to learn the sport technique gradually using all the effects that serve the required coordination and speed of movement, and avoiding the errors by using the re-presenting method combined with clarification and explanation. (26:44), the most important means of learning using computer and modern technology, which contribute to achieve the interaction of the learner and enables individual education that commensurate with the characteristics of learners and provides a learning environment with a variety of alternatives. (16:529)

This was the main reason for the researcher to conduct and implement an learning program depends on evaluating the Technique phases during learning the hammer throw Competition using DartFish Technology for the students of the Faculty of Physical Education for Boys, Alexandria University.

Research Aim

Identifying the impact of using DartFish Technology during the learning program to improve the performance of the hammer throw Competition for the students of the Faculty of Physical Education for Boys, Alexandria University.

Research Hypothesis

The learning program using DartFish Technology improves the performance of the hammer throw Competition for the students of the Faculty of Physical Education for Boys, Alexandria University.

Research Procedures

The researcher used the experimental method that include two groups (experimental and control) using post-measurement, during the academic year 2015/2016 in the field of the Faculty of Physical Education for Boys, Alexandria University. He used three Panasonic video cameras (60 Frame/sec), the kinetic analysis application (DartFish Software Team Pro 4), laptop, display device (Data show), and educational program consisting of 10 educational units.

Research Sample

The research sample consisted of (45) students (19.36 ± 0.750 years) of one studying grade which divided into two groups (experimental 20 students) who used the proposed learning program, (control 25 students) used the traditional learning program (implemented on students at the faculty). The statistical characterization of the sample is shown in table (1)

Table (1)
Statistical of the sample (n = 45)

Variables	Min	Max	Mean	SD	Skewness	Kurtosis
Age (year)	18	21	19.36	0.750	1.011	0.548
Length (cm)	166	193	177.41	7.089	0.185	-0.661
Weight (kg)	59	105	78.35	11.235	0.345	-0.381

Table (1) shows the lowest and highest values, the arithmetic mean and the standard deviation, and it shows that all Skewness, Kurtosis coefficients are confined between (±3), and that shows the compatibility between values and the homogeneity of the research sample before the main study.

Exploratory Study

The study was conducted on 05/12/2015 on a sample of three students from the research community and outside the basic sample in order to regulate and control the imaging of Technique process and determine where to place the cameras, the results clarified where to place each camera (back, side, top) in the middle of motion range, where the back and side cameras are located for about (6 m), columnar to the final edge of the throwing circle with (1.10m) height, and range for imaging is (7m) to cover the variables of release, while the upper camera is situated at a height of (4.5m), and the range of imaging is (5m) to cover the variables during the turn in the hammer release, (1.22m) ruler was captured in horizontal and vertical positions to determine the scale.

Basic Study: The research was conducted on the sample in a period from 1/5 to 6/12/2015 according to the following operational steps:

I- Pre-measurement

basic and physical measurements were conducted in a period from 1-5/11/2015 to identify the homogeneity and equivalence of the two groups of the research as shown in table (2).

Table (2)
T test to the experimental and control group in the basic and physical measurements before applying the research

Variables	Experimental n = 20		Control n = 25		"T" test	Sig.
	mean	SD	mean	SD		
Age (year)	19.45	0.826	19.29	0.690	0.69	0.492
Length (cm)	179.00	7.108	176.08	6.940	1.37	0.177
Weight (kgm)	82.00	10.887	75.36	12.482	1.92	0.062
High jump (cm)	44.55	11.399	45.18	10.103	0.19	0.850
Long jump (cm)	241.35	32.804	242.83	28.664	0.16	0.874
Throwing a 3kg ball forward (m)	10.88	1.620	10.11	1.537	1.58	0.121
Throwing a 3kg ball backward (m)	11.56	2.385	11.61	2.258	0.08	0.941
30m sprint (sec)	4.65	0.327	4.85	0.410	1.76	0.086

Table (2) shows that there were no significant differences for the "t" test value between the experimental and control group in the basic and physical measurements, which confirm the equivalence between the two groups before applying the research.

II- Learning program:

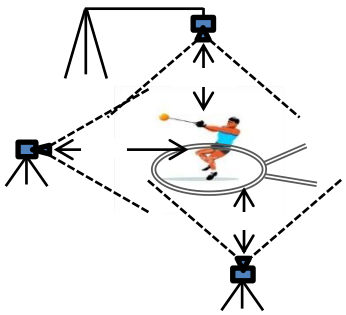
The traditional Learning program of the hammer throw, which was applied on the control group for one month was divided to (10units) according to the time plan of the semester, each unit takes (90min), and includes (20min) for warm up and physical preparation, which consists of light running on the turf and performing general exercises for all parts of the body, (60min) for Technique where the skill exercises is performed as well as Technique Learning for the hammer throw Competition, and (10min) for rest.

The proposed program was applied on the experimental group during the lecture on the same conditions, procedures and duration applied to the control group, where it took a period of time from 12/11 to 6/12/2015, taking into consideration the research articles and literature review of hammer throw (3), (5), (10), (11), (14), (21). The program contains a variety of learning exercises and skill parts, Attachment (1), with continuous learning and evaluation of Technique by immediate feedback using DartFish application, Attachment (2).

III- Post-measurement

Post-measurement was conducted on 6/12/2015 by imaging the Technique of hammer throw for both groups of the research, where the cameras were placed according to the results of the Exploratory study as shown in Figure (1). All the sample attempts for individuals were recorded by which three attempts for each student, to choose the best attempt with the longest distance of throwing the hammer for motor analysis using DartFish Software Team Pro 4, to extract the biomechanical variables of Technique to the hammer throw, to process the statistical data.

Figure (1)
the locations and dimensions of the cameras during imaging the Technique of the hammer throw



Statistical Processors: arithmetic mean, standard deviation, percentage, Skewness and kurtosis coefficient and T test.

Results

Table (3)
T test to the experimental and control group for the supports Duration and knee angle in the hammer throw Competition

Variables	Experimental n = 20		Control n = 25		Difference Percentage %	"T" Test	Sig.
	mean	SD	mean	SD			
Single support time (SST) (s)	0.47	0.07	0.41	0.11	14.63	2.12*	0.040
double support time (DST) and release (s)	0.44	0.07	0.61	0.15	27.87	4.71**	0.000
Total time for turn and release (sec)	1.19	0.16	1.34	0.16	11.19	3.07**	0.004
Knee angle during Single support (degree)	136.75	9.633	136.16	9.754	0.43	0.20	0.843

Table (3) shows significant differences between the experimental and control group at supports Duration during turn. The percentage of difference ranged between (11.19%, 27.87%), the Knee angle during Single support was (0.43%) in favor to the experimental group.

Table (4)
T test to the experimental and control group in angular displacement and average angular velocity of the Shoulders and hammer during supports in the hammer throw Competition

Variables		Experimental n = 20		Control n = 25		Difference Percentage %	"T" test	Sig.
		mean	SD	mean	SD			
Angular displacement during supports (angle)	Shoulders Twisting	182.98	39.530	145.65	45.632	25.63	2.89**	0.006
	Hammer turn	166.14	32.346	118.63	41.108	40.08	4.09**	0.000
Average angular velocity during supports (angle)	Shoulders Twisting	385.50	53.599	355.39	62.423	8.47	1.71	0.094
	Hammer turn	353.00	55.684	288.49	73.356	22.36	3.25**	0.002

Table (4) shows significant differences between the experimental and control group at angular displacement and average angular velocity of the Shoulders and hammer during supports. The percentage of difference ranged between (8.47%, 40.08%) in favor to the experimental group.

Table (5)
T test to the experimental and control group for hammer and variables during release in the hammer throw Competition

Variables		Experimental n = 20		Control n = 25		Difference Percentage %	"T" test	Sig.
		mean	SD	Mean	SD			
Hammer velocity in the beginning of turn (m/s)	Vertical	2.28	1.618	2.82	1.999	19.50	0.99	0.329
	Horizontal	8.73	1.391	5.90	1.507	47.97	6.47**	0.000
	Resultant	9.15	1.390	6.93	0.846	32.03	6.60**	0.000
Hammer Velocity at release (m/s)	Vertical	9.68	2.273	7.60	2.475	27.37	2.89**	0.006
	Horizontal	12.10	2.532	8.84	2.392	36.88	4.43**	0.000
	Resultant	15.60	2.832	11.94	2.243	30.74	4.85**	0.000
height of Release (m)		1.70	0.164	1.73	0.208	1.73	0.58	0.566
angle of release (degree)		37.98	6.393	39.72	12.301	4.38	0.57	0.569
Elbow angle during release (degree)		159.98	20.514	141.82	21.523	12.80	22.85**	0.007

Table (5) shows significant differences between the experimental and control group at Hammer velocity and variables during release. The percentage of difference ranged between (1.73%, 47.97%) in favor to the experimental group.

Table (6)
T test to the experimental and control group in the Hammer distance in the hammer throw Competition

Variables	Experimental n = 20		Control n = 25		Difference percentage %	"T" Test	Sig.
	mean	SD	mean	SD			
distance (m)	24.40	4.489	17.40	3.884	40.23	5.61**	0.000

Table (6) shows significant differences between the experimental and control group at the Hammer distance. The percentage of difference was (40.23%) in favor to the experimental group.

Discussion

It is clear from tables (3), (4) that Total time for turn and release for the experimental group was 1.19 sec. with 11.19% less than the control, and (DST) and release was less by 27.87%, while (SST) was greater in the experimental than the control because the experimental group members performed a complete turn, where the Angular displacement during supports for Shoulders was 182.98 degrees with 385.50 degrees for Average angular velocity, whereas the control was 145.65 degrees with 355.39 degrees for the Average angular velocity and the difference percentage was 25.63%. The Angular displacement during supports to the hammer was 166.14 degrees for the experimental while the control was 145.65 degrees and the difference percentage was 40.08% in favor to the experimental group.

The results were due to instant evaluation for the Technique of the experimental group using DartFish application. The experimental performed the turn at high speed in a short time during turn and release, while the (DST) and release a longer time for the control to overcome the incomplete turn, which in turn led to an increase in (DST) and release. The knee angle of (SS) leg of the experimental was better by 0.43% through a large bend of the knee, which works on balance, stability and control in the hammer through the turn. Bartenz (2008) pointed that the lowest level of the body must be maintained during turn, and then the legs have to be fully expanded during release. (3:484)

During the (DS) duration, the horizontal and vertical velocity increase. To achieve the maximum effectiveness, the horizontal velocity must be improved during this duration; the Vertical velocity can also be improved. During the phases of (SS) of turn, the player can increase the Vertical velocity, if he had to. (2:78)

It is clear from table (5) that the Resultant velocity of the hammer at the beginning of turn for the experimental group (9.15m/s) was greater than the control (6.93m/s) with difference percentage 32.03%, which shows that preliminary swinging and preparing for turn were better at high velocity in the experimental, while there was fluctuation in the hammer path in the control through increasing the vertical velocity of the hammer by 19.50%, whereas there was a difference by 47.97% in the horizontal velocity of the hammer in favor to the experimental.

The resultant velocity of the hammer at release was 15.60m/s. in the experimental group which was greater than the control which was 11.94m/s. with difference of 30.74%, and an increase in horizontal velocity with difference of 36.88% and vertical velocity with difference at 27.37%, and this shows the high velocity of the hammer during release in the experimental. The increase in hammer velocity from starting the turn until release was 6.45m/s for the experimental which was greater than the control with 5.01m/s and this indicates the increased velocity during turn. In order to overcome the little velocity of the control, the angle and height of Release were increased with 39.72 degrees, while it was 37.98 degrees for the experimental with difference of 4.38% in favor to the control.

The angular velocity of the hammer increases gradually during the turn due to the increase that occurs during supports. We would find that the half of the diameter increases in (SS), and decreases in the (DS) and has an effect on the velocity of the hammer. (18) The relationship between initial and final angular velocities is one of the important factors in the throw movement. Throw technique is effective when a player increases the acceleration from one phase to another to enhance the angular velocity, which transmits in turn to the hammer velocity. (3:474)

Turns are the best opportunity to increase the horizontal velocity. The vertical velocity is also a very important component of the Resultant velocity of the hammer. Andreas (2009) Holds that focusing on (DS) phase may be

misplaced in increasing the hammer velocity. This does not mean that (DS) phase is not important, but there other aspects work on increasing it when throwing and releasing. (2) while Dapena, J. (1989) suggests increasing the hammer velocity generally and effectively during (DS) phases for throwing, because the hammer velocity increases between the high and low points of its orbit which almost coincides with the start and the end of (DS) phase respectively. (6) Hammer velocity can be increased in (DS) and (SS) phase during turns by increasing the vertical velocity and decreasing half of the diameter of the hammer. (19)

The increase in hammer velocity is associated with generating intention for turn around the horizontal axis which means that the increase in velocity is vertical velocity and a little part to the horizontal velocity for the hammer that increase effectively during (DS) more than (SS). However this only happens when the player turns very slowly, but when he turns quickly it becomes impossible to increase the horizontal velocity at any phase of support. (7) (6)

The velocity generated of turns and the release is resulted from transferring the energy of acceleration to the different parts of the body in the least possible time while reducing the phases of damping during (SS) phase, at the end of (DS) phase, to achieve a high level of required ability during release. (3) The velocity of the hammer release has the effective role in flight distance, which arises from the gained movement and speed through swings and turns. This is linked to a positive relationship with the length of the hammer distance. (26:29)

The Elbow angle during release in the experimental group was 159.98 degrees greater than the control which was 141.82 degrees with difference of 12.8%, and this reflects the proper release in the experimental, this is due to the instant evaluation and errors correction during the phases of Technique. If turn is performed properly, velocity will increase smoothly during turn. Here comes the final acceleration through the extending the joints of the body with pushing with the right leg and concentrating on proper release. (13)

Improvement results in biomechanical variables and Technique led to improving the hammer throw distance with 24.40m for the experimental group greater than the control which was 17.40m with a difference of 40.23%. Success in hammer throw Competition requires proper biomechanical variables for throwing, which is the player's skill in throwing from optimal angle close to 45 degrees, the proper power, the body mass for balance, the length of half of the diameter of the throwing arm and the velocity during release. (12)

The hammer distance is determined according to release velocity, height and angle of release and air resistance. The hammer Velocity is the most important factor in throwing. The proper release angle to the players ranges from 34 to 44 degree. (3) Some studies have shown that release angle of female players ranged between 29 and 42 degree. However, the angle of 44 degree is optimal for both male and female players. (4) The initial release velocity determines crucial victory or defeat on the competitive level. (20), (18)

The achieved improvement in results is due to using the proposed learning program by instant evaluation for the Technique using the DartFish application on the experimental group that showed efficiency through improving and developing the performance of turn at high velocity in least time, quick release and proper angle. The learning process aims to learn performing various motor skills by the coach through facilitating the various movements avoiding the common mistakes as possible. (25:246)

The skill provided by the coach that has no reaction from the players cannot make any success, because the player's ability to understand the movements depends on the extent of awareness of their details and his response to all audio and visual effects and correcting errors through the learning process. (25:248) learning by using computers and modern technology provides information and opportunities for the learner to let him seek for right solutions by himself, also simulation makes learning more exciting and helps learners to improve their skills, while multiple learning methods make the player more effective and integrated in learning and developing skills and evaluating results. (16:551)

Computer facilities can help in training the champions as to win competitions. It was clear that a lot of the athletes who participated in the 2004 Olympics in ATHENS, and a similar percentage among medal winners in this event have been trained by DartFish company applications. At the 2002 Winter Olympics in Salt Lake City, 45 medals were achieved thanks to those programs that use digital video camera to develop the training, to compare between players performances, to measure the movement time, and to correct the positions taken by each player during performance by comparing between the details of sports movements. (1:18)

According to results discussion, the research hypothesis was validated. The proposed learning program using DartFish Technology improves the performance of the hammer throw Competition for the students of the Faculty of Physical Education for Boys, Alexandria University.

Conclusions

1- The proposed learning program using DartFish Technology to evaluate the Technique led to improve supports times, velocity of turn and release in hammer throw Competition for the students of the Faculty of Physical Education for Boys, Alexandria University.

2- The proposed learning program using DartFish Technology to evaluate the Technique led to improve Technique and the hammer throw distance for the students of the Faculty of Physical Education for Boys, Alexandria University.

Recommendations

1- It is important to implement the proposed learning program using DartFish Technology to evaluate the Technique in teaching hammer throw Competition for the students of the Faculty of Physical Education for Boys, Alexandria University.

2- The instant Evaluation Technique is important during teaching and training complex skills and throw Competitions.

3- Learning programs design for throw Competitions using modern technology and analysis Technique applications.

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