ANALYZING AND COMPARING THE SKILL EFFECTIVENESS BETWEEN SUCCESSFUL AND UNSUCCESSFUL FEMALE VOLLEYBALL TEAMS IN THE NATIONS LEAGUE WOMEN'S VOLLEYBALL TOURNAMENT 2019

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Abstract

Purpose This study aimed to analyze the volleyball skill effectiveness between the successful and unsuccessful female volleyball teams participating the Nations League 2019 Tournament.

Methods During this tournament, all events were live-broadcasted via YouTube and analyzed by Sports Performance Analysis Center, SPAC, Faculty of Sports Sciences, Kasem Bundit University to rank team by player performance. Volleyball analytics consisted of sports performance analysis and database system for scouting, evaluating and classification, and team performance ranking of all teams. Six scouting key performance indicators including, serving, service receiving, setting, spiking, spiking receiving and blocking with corresponding results of either getting or losing a point or nothing by team from all sets and matches in the tournament were collected for ranking. Advanced Performance Analysis software (Focus X2 version 1.5) was used to summarize collected scouting data and were presented in terms of frequencies, percentages, and means and standard deviations. Independent-samples t-test and Kendall's Correlation were employed for data analysis at $p < .05$ level of significance.

Results Correlations of the effectiveness of spiking skills between successful teams and those of unsuccessful teams were 0.393 and -0.400, respectively. By comparing skill effectiveness, only spiking skill exhibited significant difference at $p < 0.05$ level.

Conclusion Spiking is the most important skill determining the success of the teams in the National Volleyball Tournament 2019.

Keywords: Volleyball Analytics, Volleyball Skills, ServeIndex, SpikeIndex, SetIndex, Successful Team, Unsuccessful Team.

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INTRODUCTION

Nowadays, Volleyball at the international competition is on the rise, consisting of different levels of competitions including SEA Games, Asian Games, Olympic Games, and World Championship.

Among these, the Volleyball Nation League 2019 is one of the most prestigious event world top ranking which has attracted many the world top ranking and it is an important event before the World Grand Prix .

In volleyball, there are both offensive and defensive skills, such as serving, service receiving, spiking, spike-receiving, setting, and blocking. It is assumed that successful and unsuccessful teams possess different levels of these skills.

As a result, the research team is interested in comparing volleyball skill effectiveness among successful and unsuccessful women's volleyball teams in the 2019 Nation League Women's Volleyball Tournament.

METHODOLOGY

Volleyball analytics steps are computer-aided scouting, database compilation and analysis to perform ranking calculation, statistical analysis for insight about skill effectiveness equation, performance indicators relationship and comparative analytics to provide a key performance indicators to differentiate among successful teams (Rank 1-3) and unsuccessful teams (Rank 4-6).

COMPUTER-AIDED SCOUTING

Computer-aided scouting is the process of using Sports Performance Analysis software, like ***Focus X2*** to capture key performance indicators of Volleyball players for both live and post-performance analyses.

Volleyball event has six players in each competing team. National volleyball woman teams form China, United States, Brazil, Italy, Turkey and Poland participated in the Nation League Women Volleyball Tournament 2019 Final. In this study, these six teams competing ten matches in final round were analyzed.

The final six teams were divided into two groups of three teams each, where they had to compete in a head-to-head match. At the end of the competition, the top two in each group advanced to the semifinals. In semifinals, the winning teams proceeded to the final. The losing teams competed for the 3rd place.

PLAYER POSITION, SKILL, and RESULT are primary scouting parameters in Volleyball and classified as category set or tag template for computer-aided scouting.

In typical computer-aided scouting, tag templates are typically designed in the format of category set of buttons to form a simple sentence as "Who?" "Does what?" and "What is the Result?". Pushing one button in each category accomplishes a complete event to be recorded.

So, we have the first set of buttons categorized and designated as "PLAYER

POSITION" set with three buttons, namely, SERVER, SETTER, and SPIKER as the "Who?" part of the syntax for scouting tag template. The second set of buttons can be categorized and designated as "SKILL" set performed by a player with six possible buttons, namely, SERVE, SERVICE-RECEIVING, SET, SPIKE, SPIKE-RECEIVING and BLOCK as "Does what?" part of the syntax for scouting tag template.

And the third set of buttons can be categorized and designated as "RESULT" set indicating a result of skill performed with three possible buttons, namely, POINT, NOTHING and LOST as "What is the Result?" part of the syntax for scouting tag template.

While the competition is ongoing live or a videotape is being rerun on video windows of Focus X2 software, scouting or recording an event can be accomplished simultaneously by pushing one button in each category set to complete an event. For example, when a server can serve successfully across over the net while the opponent can also receive it successfully. SERVER button from PLAYER POSITION category set must be pushed to record the "Who?" of this event is SERVER, then SERVE button from SKILL category set must be pushed to record the "Does what?" of this event is SERVE, and finally ServePass button from RESULT category set must be pushed to complete the event by specifying that no point has been made out of this service with SERVER ServePass record as an event in the system. Computer-aided scouting is repeated for each subsequent event until the end of the set. The system will provide statistics of all events recorded, and give possibilities to export highlight video clips of selected events for review of subset exclusively without the pain of rerunning the whole tape again and again and searching for a particular instance of video painstakingly.

VOLLEYBALL TECHNICAL TERMS AND CODING FOR SCOUTING

In live scouting or post-event scouting, it is convenient to set up symbols for quick and

Skill	+1 point	+1 point	0 point	-1 point	-1 point
Serving	ServeAce	ServePoint	ServePass	ServeNet	ServeOut
Service Receiving	-	-	SvRecPass	SvRecNet	SvRecOut
Setting	-	-	SetPass	SetNet	SetOut
Spiking	SpikeAce	SpikePoint	SpikePass	SpikeNet	SpikeOut
Spiking Receiving	-	-	SpRecPass	SpRecNet	SpRecOut
Blocking	-	BlockPoint	BlockPass	BlockNet	BlockOut

Figure 1. Skill and result combinations.

correct scouting fromVolleyball terminology.

Serving (Sv)

(+) SvAce: a service into the opponent team area without getting into contact with any opponents players and winning one score.

(+) SvPoint: a service into the opponent team area and getting into contact with some opponent players who cannot continue the play and winning one score.

(0) SvPass: a service to the opponent team area and play can continue, no score winning or losing.

(-) SvNet: a service into the net and the ball falls into the court of serving team and losing one score.

(-) SvOut: a service that the ball falls outside or beyond playing area and losing one score.

Service Receiving (SvRe)

(0) SvRecPass: the receiving team can receive the ball properly and continue the play.

(-) SvRecNet: the receiving team cannot receive the ball properly as it goes against the net and falls to ground on the receiving side and loses onc score.

(-) SvRecOut: the receiving team cannot receive the ball properly as it bounces outside playing area and loses one score.

Setting (St)

(0) StPass: the receiving team can set the ball to the next play.

(-) StNet: the receiving team sets the ball against to the net and back into its own playing area and loses one score.

(-) StOut: the receiving team sets the ball out of playing area and loses one score.

Spiking (Sp)

(+) SpAce: the spiking team spikes into the opponent team playing area without getting into contact with any opponent players and wins one score.

(+) SpPoint: the spiking team spikes into the opponent team playing area with getting into contact with one or more opponent players who cannot continue the play and wins one score.

(0) SpPass: the spiking team spikes into the opponet team playing area and the play can continue,

(-) SpNet: the spiking team spikes into the net and the ball falls back into the playing area of the spiking team and loses one score.

(-) SpOut: the spiking team spikes outside or beyond the playing area of the opponent team and loses one score.

Spiking Receiving (SpRe)

(0) SpRecPass: the receiving team can handle the spiked ball and continure the play, no score winning or losing.

(-) SpRecNet: the receiving team cannot handle the spiked ball as it goes against the net and falls to ground on the receiving side, and loses on score.

(-) SpRecOut: the receiving team cannot handle the spiked ball as it goes outside or beyond playing area, and loses one score.

Blocking

(+) BlkPoint: the receiving team can block the spiked ball so that it successfully falls back into playing area of the spiking team and wins one score.

(0) BlkPass: the receiving team can block the spiked ball so that it falls back into playing area of the spiking team who can still continue the play.

(-) BlkNet: the receiving team cannot block the spiked ball properly as it goes to the net and falls back into playing area of the receiving side and loses one score.

(-) BlkOut: the receiving team cannot block the spiked ball properly as it goes outside or beyond playing area and loses one scorue.

RANKING PROCEDURE

A ranking system simply ordered items based on a particular key under consideration or assessment criterion.

The following equations define service-related scouting data into ServeIndex as a ranking criterion for servers, i.e., every player's service-related scores were computed into his/her ServeIndex using equation (1) to (5) and ranked accordingly.

$$ServeAllPoint = ServeAce + ServePoint \quad (1)$$

$$ServeLoss = ServeNet + ServeOut \quad (2)$$

$$ServeGross = ServeAllPoint\text{-}ServeLoss \quad (3)$$

$$ServeTotal = ServeAllPoint + ServePass + ServeLoss \quad (4)$$

$$ServeIndex = \frac{ServeGross/}{ServeTotal} \% \quad (5)$$

Likewise, spiking-related scores were computed as per equation (6) to (10) into SpikeIndex for ranking spikers.

$$SpikeAllPoint = SpikeAce + SpikePoint \quad (6)$$

$$SpikeLoss = SpikeNet + SpikeOut \quad (7)$$

$$SpikeGross = SpikeAllPoint - SpikeLoss \quad (8)$$

$$SpikeTotal = SpikeAllPoint + SpikePass + SpikeLoss \quad (9)$$

$$SpikeIndex = \frac{ServeGross/}{ServeTotal} \% \quad (10)$$

In the same way, setting-related scores were computed as per equation (11) to (14) into SetIndex for ranking setters.

$$SetLoss = SetNet + SetOut \quad (11)$$

$$SetGross = SetPass - SetLoss \quad (12)$$

$$SetTotal = SetPass + SetLoss \quad (13)$$

$$SetIndex = \frac{SetGross/}{SetTotal} \% \quad (14)$$

Although each player position; has been ranked more criteria to prepare for drafting is still needed. A Volleyball server do not only serve, while a spiker do not only spike. In addition, different position players play other skills that contributed to getting or losing scores causing the team to win or lose a game. No other position except servers can serve, but servers seldom block, as their positions in the court are usually away from the net area, some servers did spike and setting at times besides receiving service and receiving spiking from their opponents.

A ValueIndex of each player was calculated from equation (15) to (17), where each gross value represented the gross contribution from that skill, and each total value represents total occurrences of that skill.

$$ValueGross = ServeGross + ServeRecGross + SetGross + SpikeGross + SpikeRecGross + BlockGross \quad (15)$$

$$ValueTotal = ServeTotal + ServeRecTotal + SetTotal + SpikeTotal + SpikeRecTotal + BlockTotal \quad (16)$$

$$ValueIndex = \frac{ValueGross/}{ValueTotal}\% \quad (17)$$

SUCCESSFUL TEAMS AND UNSUCCESSFUL TEAMS

Successful Teams were top three ranking teams in the final round of the tournament.

Unsuccessful Teams were teams with rank four to six in the final round of the tournament.

Once Volleyball analysts have scouted all sets in the tournament and compiled all scouting data into a database system, the next step will be ranking and statistical analysis.

RESULTS AND DISCUSSIONS

The scouting of events of FIVB Volleyball Nations League 2019 aimed to analyze the effectiveness of six skills of six teams from ten matches in final round among successful teams, namely, USA (1st), Brazil (2nd), and China (3rd) with respect to unsuccessful teams, namely, Turkey (4th), Italy (5th), and Poland (6th). Effectiveness of six volleyball skills in (Serve, Spike, Set, Block, Service Receive, Spike Receive) were shown in the figure below;

Rank	Team	SvAces+SvPoint	SvNet+SvOut	SvPass	Attempts	%Success
1	Turkey	121	176	1259	1556	7.8
2	USA	121	194	1338	1653	7.3
3	Italy	110	203	1199	1512	7.3
4	China	108	100	1284	1492	7.2
5	Poland	88	152	1300	1540	5.7
6	Brazil	79	132	1366	1577	5.0

Figure 2. Final six teams in Server ranking using ServeIndex as a ranking criterion.

Rank	Team	SpAce+SpPoint	SpNet+SpOut	SpPass	Attempts	%Success
1	USA	1026	284	997	2307	44.5
2	Italy	918	331	864	2113	43.4
3	China	851	222	890	1963	43.4
4	Brazil	926	286	936	2148	43.1
5	Turkey	906	339	918	2163	41.9
6	Poland	911	348	989	2248	40.5

Figure 3. Final six teams in Spiker ranking using SpikeIndex as a ranking criterion.

Rank	Team	StPass	StNet+StOut	Attempts	%Success
1	USA	2265	20	2285	99.1
2	Brazil	2137	20	2157	99.1
3	Turkey	2161	31	2192	98.6
4	China	1919	28	1947	98.6
5	Italy	2073	32	2105	98.5
6	Poland	2237	45	2282	98.0

Figure 4. Final six teams in Setter Team ranking using SetIndex as a ranking criterion.

Rank	Team	BlkPoint	BlkNet+Out	BlkPass	BlkAll	%Success
1	Turkey	195	384	496	1075	64.3
2	Italy	169	381	449	999	61.9
3	Brazil	174	429	495	1098	60.9
4	USA	173	455	551	1212	59.7
5	China	161	406	417	984	58.7
6	Poland	180	460	459	1099	58.1

Figure 5. Final six teams in Blocking Team ranking using BlockIndex as a ranking criterion.

Rank	Team	SvRecPass	SvRecNet+Out	SvRecAll	%Success
1	Brazil	1171	76	1247	93.9
2	USA	1261	86	1347	93.6
3	Italy	1183	83	1266	93.4
4	Poland	1297	91	1388	93.4
5	Turkey	1196	85	1281	93.4
6	China	1073	95	1168	91.9

Figure 6. Final six teams in Setter Team ranking using Service Receiving Index as a ranking criterion.

Rank	Team	SpRecPass	SpRecNet+Out	SpRecAll	%Success
1	Italy	1171	195	1366	85.7
2	Brazil	1282	225	1507	85.1
3	Turkey	1264	230	1494	84.6
4	USA	1338	249	1587	84.3
5	China	1129	223	1352	83.5
6	Poland	1276	259	1535	83.1

Figure 7. Final six teams in Setter Team ranking using Spiking Receiving Index as a ranking criterion.

Rank	Team /	Effectiveness Serving Eff.	Spike Eff.	Setting Eff.	Blocking Eff.	Rec Spike Eff.	Rec Serve Eff.	Scoring Eff.	Award
1	Turkey	7.8	41.9	98.6	64.3	93.4	84.6	**65.10**	**4th**
2	Italy	7.3	43.4	98.5	61.9	93.4	85.7	**65.03**	**5th**
3	USA	7.3	44.5	99.1	59.7	93.6	84.3	**64.75**	**1st**
4	Brazil	5.0	43.1	99.1	60.9	93.9	85.1	**64.52**	**2nd**
5	China	7.2	43.4	98.6	58.7	91.9	83.5	**63.88**	**3rd**
6	Poland	5.7	40.5	98	58.1	93.4	83.1	**63.13**	**6th**
Average		**6.72**	**42.80**	**98.65**	**60.60**	**93.27**	**84.38**	**64.40**	

Figure 8. Final six teams ranking using Scoring Effectiveness as a ranking criterion.

Now, we have a Scoring Effectiveness that reflects the value of team regardless of her position in terms of net contribution to the win or loss of the team. On the other hand, the successful team (Award 1-3) are ranked differently with respect to scoring effectiveness.

Volleyball is a kind of sports for two opposing teams to play for points or scores, offensive technical skills are used to win the game rather than defensive technical ones. Offensive skills in volleyball are Spiking and Serving.

USA(1st) achieved most scores from spiking, the most aggressive offensive skill to beat competition hard with power without fear of losing and paved the road to championship. While Brazil (2nd) and China (3rd.) were good in both offensive and defensive skills, but relatively weaker in terms of spiking scores and more prone to committing errors.

Among the Unsuccessful Team, Turkey (4th) was the best in Serve Effectiveness and Block Effectiveness but not good in Spike Effectiveness, Italy (5th) was the best in Receive Effectiveness but not good in offensive skills also Poland (6th) was the lowest in five out of six effectiveness.

Team	Serving	Spiking	Setting	Blocking	Rec Spiking	Rec Serving
Successful	.964	.037*	.274	.342	.319	.256
Unsuccessful	.964	.036*	.199	.219	.236	.361

Figure 9. Comparative Skills between Successful and Unsuccessful Teams

Correlation Effectiveness	Successful Team		Unsuccessful Team	
	Kendall-Correlation	p-value	Kendall-Correlation	p-value
Spiking	.393	.037*	-.400	.036*
Blocking	.179	.342	-.234	.219
Serving	-.009	.964	-.009	.964
Setting	.211	.274	-.250	.199
Spike-Receiving	.188	.319	-.226	.236
Serve-Receiving	.216	.256	-.176	.361

*p < .05

Figure 10. Correlations between effectiveness of skills and Successful-Unsuccessful Teams.

Team	Serving	Spiking	Setting	Blocking	Rec Spiking	Rec Serving
Successful - Unsuccessful	1.000	.009*	0.653	0.150	0.728	0.601

*p < .05

Figure 11. Correlation of Spiking among Successful-Unsuccessful Teams.

A ranking was based on raw scores of team skill and on the assumption that each skill had the same weight for contribution as a ServePoint got one score, while a SpikeNet lose equally one score. Correlation analysis (Albert et al., 2005) as shown in Figure 10 reflects that successful teams correlate to effectiveness of spiking scores statistically significantly. Spiking correlated significantly positively at the 0.05 level to successful team with r = .037* and comparative skill difference between successful team and unsuccessful team at 0.05 level is spiking skills with p = .009*

In terms of skill, there was a relationship between the effectiveness of offensive skills and the successful team. Correlation was 0.393 and the effectiveness of spiking skill at loss with correlation of -0.400 in unsuccessful team which was statistically significant at 0.05 (Kendall-Correlation).

In the comparison of skill effectiveness, The difference between a successful team and an unsuccessful team. The difference in spiking skills was statistically significant at 0.05 level.

Furthermore, detailed statistical analysis (Tharenou et al., 2007) revealed that spiking capability determined significantly the most to the winning of the team, while the second most important skill was serving (Subprasert, 2015). Therefore, a combination of the right skills for a team and club are crucial decisive choices for scoring.

The results clearly demonstrated that the decisive differentiating skill between successful team and unsuccessful team was the spiking skill. Spiking skill is the score making skill that any team determining to be a champion should focus to hone their spiking supremacy to the best possible arsenals to gain top-notch advantages to any competition.

CONCLUSIONS

The ultimate benchmark and Hall of Fame of achieving success in sports are championship or gold medals. Ranking achievement requires systematic approach in assessing key skill effectiveness in a particular sport, especially team sports. In volleyball there are six key technical skills contributing to varying degree of success to the team. Thanks to advanced computer technology, sports events can be analyzed live or post-event with high degree of

accuracy and speed. In this study, computer-aided scouting software was used to rank the effectiveness of those six volleyball skills from six teams and ten matches in the final round of the Nations League 2019 Tournament by scouting and evaluating the effectiveness of each skill by using formulae derived from volleyball terminology in their effects towards winning or losing a point or score in competition for ranking and as well as determining their correlation with success statistically.

To conclude, it was found that spiking skill contributed most to the success of the team, and the only skill that stood out statistically to differentiate winners from losers, the successful from the unsuccessful.

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