



Identifying the Optimal Age to learn Water Polo Tactics according to Expert Opinion: Insights through Dimensionality Reduction Analysis

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Abstract

Background. It is of great importance that the training process of youth water polo players be tailored to didactic principles and developmental characteristics. However, despite this importance, there is a dearth of pertinent studies.

Objectives. The study aimed to determine and explain the appropriate age for beginning of learning tactical elements in water polo, as stated by experts' coaches' opinion in this sport.

Materials and methods. Accordingly, 27 expert water polo coaches completed a novel questionnaire, specifically designed for this study.

Results. Test-retest reliability indicated satisfactory scores (r ranged from 0.85 to 1.00 with $p < 0.05$ for all variables). The results of the exploratory factor analysis using the Guttman-Kaiser criterion for selecting the number of factors and the Varimax raw rotation revealed the presence of six underlying factors in real-life contexts: (1) individual and group activities with a numerical advantage/disadvantage; (2) dynamic-complex collective defensive activities with an equal number of players; (3) intensive defensive activities with an equal number of players, static defensive activities with a numerical handicap and collective offensive activities with a numerical advantage; (4) static-vertical attacking activities with a numerical advantage, attacking activities with an equal number of players and dynamic defensive activities with a numerical handicap; (5) static-vertical defensive activities with an equal number of players; (6) extremely rare offensive activities which explain 19%, 16%, 17%, 11%, 11%, 6% of the manifest space variability, respectively.

Conclusions. The present findings highlight novel insight into experts' opinions regarding the learning of complex water polo movements, and offer essential guidance for key stakeholders pertaining to optimizing the training processes and curricula for all youth water polo players.

Keywords: water polo experts, tactical elements, new teaching methodology, didactic principles, early specialization.

Introduction

The training plan is mainly compiled according to certain criteria and epistemological and didactic knowledge in order to determine the technical and tactical skills. Tactics in water polo is one of the most important areas, as the outcome of the game largely depends on it. Tactics can only be decisive if a player has an excellent command of the technique of water polo and is well prepared in terms

of fitness. Tactics is the planning of how to use the available resources for the game and answers the question of how to play (Hraste, 2021). Individual tactics represent the game plan of an individual. Group tactics represent the game plan of two or more players, but not all of them. Collective tactics represent the game plan of all players. Every complex human movement takes place in a certain order; this also applies to training and development. In the training process, the areas, intensities and sequences of the training content to be taught are determined. For young water polo players, the perception of the (de)motivational style of their coaches is very important for the motivational results they report and their sporting commitment (Murillo et al., 2022). Changes

in pedagogical practice aimed to help players understand and use interventions to support the improvement of young futsal players and emphasized a new understanding of playing and coaching practices and the importance of critical player observation when thinking about how to develop supportive pedagogical practices (Ginciene et al., 2023). Research on young soccer players suggested that declarative tactical knowledge in the football team is different at different ages (Américo et al., 2016; Matos et al., 2019). The implementation of a program that included two different methods for teaching/learning football technique and tactics in young players led to improvements in participants' learning (García-Ceberino et al., 2020). The results on football tactical knowledge in the U-10, U-13 and U-16 age groups and three categories of high, medium and low competitive experience show that the improvement of declarative and procedural tactical knowledge in the early years influences the future success of individuals in football (Serra Olivares et al., 2021). A longer period of repetition and improvement is required from the beginning of learning tactical knowledge in young athletes to its application in situational conditions (de Castro Júnior et al., 2020). Coaches and athletes have been clearly identified as having difficulty recognising tactical potential, an important construct in the assessment of tactical skills (Silva et al., 2023). The acquisition and development of tactical skills in young athletes is variable and non-linear, and the need for continuous assessment during the training process across age is warranted (Praça et al., 2017; de Castro Ribeiro et al., 2021). For the first time, a study identified and explained coaches' opinions on the optimal age for learning a set of 39 water polo technique elements (Hraste et al., 2023). Unfortunately, we are not aware of any studies that have looked at expert opinion to determine the optimal age for the acquisition of tactical knowledge, either in water polo or any other sport.

The didactic principles are general norms through which the teaching-learning-assessment is put into practice, so that the functioning of the objectives/competences becomes efficient at the level of the educational dimension (Marius-Costel, 2010). When arranging the learning content, some of the basic didactic rules of gradation are usually followed, i.e. from the easier to the more difficult, from the simpler to the more complex and from the known to the unknown (Bjelica & Bilić, 2008). A top water polo player must be strong, fast and persistent as well as technically and tactically well developed. For a water polo player to achieve the highest quality, years of systematic and methodically correct training are required. In the search for an optimization of the training process according to the developmental characteristics of the children, a new teaching methodology was defined and explained (García-Angulo et al., 2019). By determining the optimal age for learning tactical skills, we can avoid early specialization. A focus on specialized training in the early stages of development has been associated with several negative consequences (Baker, 2003). Furthermore, for most sports there is no evidence that intensive training and specialization before puberty are necessary to achieve elite status (Jayanthi et al., 2013). A number of recent published studies have used objectively measurable indicators of the technical and tactical activities and efficiency of water polo (Tucher et al., 2015; Vila et al., 2011; Alcaraz et al., 2012; Lupo et al., 2014). Unfortunately, there is a relative paucity

of studies on the technical and tactical aspects of youth water polo (Hraste et al., 2014; Hraste et al., 2016; Falk et al., 2004). Water polo consists of polistructural complex movements which are performed without the ball in the phase of defence and with or without the ball in the phase of offense. From the perspective of the structural analysis of playing, there are three domains of playing: defence, offense and transition (conversion). According Hraste (2021) the phase of a set defence is the phase of play which begins with the conclusion of transition from offense to defence. The main goal of playing in a set defence is to use an appropriate tactical variant to stop the opponent's set offense and to regain the ball. In the phase of a set defence we differentiate three game systems: (1) system of press defence; (2) system of zone defence; (3) system of combined defence. The main difference between a press defence and a zone defence consists in the fact that during press defence a player guards his opponent directly and in zone defence a player guards the space in front of the opponent. Approximately 80% of movement in a press defence is performed in a horizontal and a semi-horizontal position, and around 20% is performed in a vertical and a semi-vertical position. In a zone defence approximately 70% of movement is performed in a vertical and a semi-vertical position and around 30% in a horizontal and a semi-horizontal position (Hraste, 2021). Combined defence is a system of play in which certain players play zone system and the other players do press defence at 8 meters from their own goal. The principle of this system of playing is to use press defence to guard better shooters or ball distributors while the system of zone defence guards against weaker shooters. The goal of conversion from defence to offense is a quick arrival from the area of defensive actions to the area of offensive actions after regaining the ball while the aim of conversion from offense to defence is a quick arrival to an area of defensive actions from an area of offensive actions after losing the possession of the ball (Hraste, 2021). The phase of a set offense begins in the moment when the team in a counterattack did not decide to attempt to score and the defence has transformed into set defence. In the present-day water polo game, there are following variants of the offensive systems: (1) system of positional offense with one centre forward; (2) system of positional offense with two centre forwards; (3) system of positional offense without a centre forward.

Possible problems in the methodological training of water polo players may arise due to the mismatch between biological and calendar ages, which has been reported as far back as the early 1990's (Malina & Bouchard, 1991). In practice, water polo clubs divide young players according to their calendar age, not their biological age. In such situations, it is desirable to make an exception and compromise in the execution of certain technical and tactical elements, adapting them to the individual so that the development paths are as suitable as possible. Coaches of young water polo players must monitor the psychophysical changes and know the methodology of the training process in order to fulfil the basic requirements for quality and continuous work. The main hypothesis of this research is that expert opinion on tactical elements in water polo will be ordered according to didactic principles. The aim of this paper was to determine and explain the coach opinion on the optimal age of acquiring tactical knowledge in water polo. The secondary

goal was to provide precisely structured methodological guidelines to trainers/experts for training process(es) with younger age teams.

Materials and Methods

Participants

Twenty-seven water polo coaches-experts, aged 27-61y, from Croatia volunteered to take part in this study. In Croatia, there are circa 140 licensed water polo coaches, meaning the sample used in this study comprised of ~20% of the available population. In the present study, all participants attended a water polo seminar and assured that the results would be shared; accordingly, there was a 0% dropout rate. Following a detailed description of the nature of the study, all parties provided written informed consent, prior to commencing participation.

The Sample of Variables

The sample of variables to estimate the optimal age to start learning all the tactical elements known in water polo consisted of 24 elements divided into several relatively homogeneous groups. Detailed explanation and use value of each of the listed elements can be found in Hraste (2021). All tactical water polo elements are known to water polo experts.

According to the phases of the game tactics in water polo is divided into: (1) system of 'shallow' zone defence; (2) system of 'deep' zone defence; (3) system of 'M' zone defence; (4) press defence at 8 meters from the goal; (5) press defence on the defensive half of the pool; (6) press defence across the whole court; (7) system of the combined zone defence to one player; (8) system of the combined zone defence to two players; (9) system of the combined zone defence to three players; (10) system of the combined zone defence to four players; (11) individual counterattack, known as 1:0; (12) the group counterattack 2:1; (13) the group counterattack 3:2; (14) the group counterattack 4:3; (15) the group counterattack 5:4; (16) the collective counterattack 6:5; (17) man up 4-2; (18) man up 3-3; (19) active man down with shifting from one side to another; (20) semi active man down with block and occasional shifting; (21) passive and deep man down with blocks only; (22) system of positional offense with one centre forward; (23) system of positional offense with two centre forwards; (24) system of positional offense without a centre forward.

Instruments

A novel questionnaire was used to ascertain the best age tactical aspects of water polo should be learnt. Participants were asked to select one of seven options for all tactical aspects, with reference to the best time to start. The first selection available was 10 years of age, as this pertains to the first year of water polo training for youth players.

Moreover, at this age, water polo training starts in countries with similarly developed water polo provision as Croatia (Hraste et al., 2008), including Italy (De Siati et al., 2016), Spain, Greece, Serbia, and Montenegro. The final option for starting to learn certain water polo techniques was the seventh year of playing water polo, i.e. sixteen years of age.

Statistical Analysis

Descriptive statistics, including mean (M), standard deviation (SD), median (MED), and minimum (MIN), and maximum (MAX), were calculated for each item. The test-retest method was applied to assess reliability. Between test-retest correlation coefficients were utilised taken as a measure of reliability. An exploratory strategy of factor analysis, combined with Guttman-Kaiser criterion for detection of number of real-life existing factors and Varimax Raw rotation, was utilised to assess content validity and define underlying structure. Indeed, factor analyses are conducted by examining the pattern of correlations or covariances between observed measures, where it is assumed that highly correlated variables measures are plausibly influenced by the same underlying factors (Jelaska et al., 2012). For this study, type I error was set to 5% and all statistical analysis was conducted using "Statistics for Windows" ver.13.0.

Results

After the initial validation of the instrument, consultation with four coaches took place, the final version of the questionnaire was then constructed. Test-retest reliability was high: 0.85-1.00 ($p < 0.05$). Moreover, for all variables, the arithmetic mean, standard deviation, median, mode, minimum and maximum value were additionally calculated. Table 1 shows the basic descriptive indicators for the tactic variables of all phases during water polo game.

The results in Table 1 indicate that the press defence in the defensive half of the pool, the individual counterattack and the group counterattack 2:1 are already learned at the end of the second educational year of training (M-11.96; M-11.93; M-11.96). The two other press defence tactics, known as press defines 8 meters in front of the goal and the press defines over the entire playing field, are learned at the beginning of the first half of the third educational year of training (M-12.00; M-12.15). According to the results, it can be seen that the group counterattack 3:2, the group counterattack 4:3, man up 4-2, man up 3-3, active man down with shifting, semi-active man down, offense with one centre forward and positional offense without a centre forward are learned in the third educational year of training (M-12.30; M-12.81; M-12.89; M-12.44; M-12.44; M-12.37; M-12.85). Table 1 details that the shallow zone defines, the deep zone defines, the combined zone defines to one player, the combined zone defines to three players, the group counterattack 5:4, the collective counterattack 6:5, the passive man down and offense with two centre forwards belong to the fourth training period (M-13.63; M-13.74; M-13.96; M-13.96; M-13.04; M-13.63; M-13.67; M-13.70). According to Table 1, coaches teach M zone defines and combined zone defines for two and four players in the fifth year of water polo training (M-14.52; M-14.00; M-14.00).

Six relatively independent latent dimensions were isolated by factor analysis and named as follows: (1) individual and group activities with numerical advantage/disadvantage; (2) dynamic-complex collective defensive activities with an equal number of players; (3) intensive defensive activities with an equal number of players, static defensive activities with a numerical handicap and collective offensive activities with a numerical advantage; (4) static-vertical attacking

Table 1. Results of descriptive statistics for all water polo tactical variables: Arithmetic mean $\pm$ standard deviation (M $\pm$ SD), Median (Med), modal value (Mod), Minimum value (Min), Maximum value (Max)

Tactical element	M $\pm$ SD	Med	Mod	Min	Max
SHALZD	13.63 $\pm$ 0.79	14.00	14.00	12.00	16.00
DEEPZD	13.74 $\pm$ 0.81	14.00	14.00	12.00	16.00
ZONEM	14.52 $\pm$ 0.89	15.00	15.00	13.00	16.00
PRES8M	12.00 $\pm$ 0.78	12.00	12.00	11.00	14.00
PRESHC	11.96 $\pm$ 0.90	12.00	12.00	11.00	15.00
PRESWC	12.15 $\pm$ 1.13	12.00	12.00	10.00	15.00
COMZ1P	13.96 $\pm$ 0.76	14.00	14.00	13.00	16.00
COMZ2P	14.00 $\pm$ 0.83	14.00	14.00	13.00	16.00
COMZ3P	13.96 $\pm$ 0.71	14.00	14.00	13.00	16.00
COMZ4P	14.00 $\pm$ 0.96	14.00	14.00	12.00	16.00
IC1:0	11.93 $\pm$ 0.73	12.00	12.00	10.00	13.00
GC2:1	11.96 $\pm$ 0.71	12.00	12.00	10.00	13.00
GC3:2	12.30 $\pm$ 0.72	12.00	12.00	11.00	14.00
GC4:3	12.81 $\pm$ 0.68	13.00	13.00	11.00	14.00
GC5:4	13.04 $\pm$ 0.76	13.00	13.00	12.00	15.00
CC6:5	13.63 $\pm$ 0.79	14.00	14.00	12.00	15.00
MU4-2	12.89 $\pm$ 1.01	13.00	13.00	11.00	15.00
MU3-3	12.44 $\pm$ 1.01	12.00	12.00	11.00	15.00
AMDSHI	12.44 $\pm$ 1.01	12.00	12.00	11.00	14.00
SAMDBS	12.44 $\pm$ 0.75	14.00	13.00	12.00	16.00
PMDBLO	13.67 $\pm$ 0.88	15.00	15.00	13.00	17.00
OF1CF	12.37 $\pm$ 0.88	12.00	12.00	11.00	15.00
OF2CF	13.70 $\pm$ 1.10	14.00	-	12.00	16.00
OF0CF	12.85 $\pm$ 1.32	13.00	13.00	10.00	16.00

Legend: SHALZD – system of ‘shallow’ zone defence;
DEEPZD – system of ‘deep’ zone defence;
ZONEM – system of ‘M’ zone defence;
PRES8M – press defence at 8 meters from the goal;
PRESHC – press defence on the defensive half of the pool;
PRESWC – press defence across the whole court;
COMZ1P – system of the combined zone defence to one player;
COMZ2P – system of the combined zone defence to two players;
COMZ3P – system of the combined zone defence to three players;
COMZ4P – system of the combined zone defence to four players;
IC1:0 – individual counterattack, known as 1:0;
GC2:1 – the group counterattack 2:1;
GC3:2 – the group counterattack 3:2;
GC4:3 – the group counterattack 4:3;
GC5:4 – the group counterattack 5:4;
CC6:5 – the collective counterattack 6:5;
MU4-2 – man up 4-2;
MU3-3 – man up 3-3;
AMDSHI – active man down with shifting from one side to another;
SAMDBS – semi active man down with block and occasional shifting;
PMDBLO – passive and deep man down with blocks only;
OF1CF – system of positional offense with one centre forward;
OF2CF – system of positional offense with two centre forwards;
OF0CF – system of positional offense without a centre forward

Table 2. Factor analysis of expert’s opinion of optimal beginning age for learning tactical skills in water polo (Expl.Var – variability explained by single factor; Prop.Totl – proportion of variability explained by single factor)

Variable	Factors					
	1	2	3	4	5	6
SHALZD	0.28	0.40	0.08	0.09	0.77	-0.07
DEEPZD	0.20	0.21	-0.10	0.01	0.85	-0.15
ZONEM	0.05	0.66	0.13	-0.10	0.20	-0.32
PRES8M	0.32	0.07	0.85	-0.06	-0.08	0.23
PRESHC	0.28	0.09	0.84	0.07	-0.02	0.17
PRESWC	0.43	0.06	0.59	0.30	0.26	0.02
COMZ1P	0.14	0.95	0.03	0.05	-0.04	-0.03
COMZ2P	0.11	0.93	0.04	0.07	0.10	-0.02
COMZ3P	-0.02	0.80	0.12	0.16	0.46	0.14
COMZ4P	-0.06	0.68	0.05	0.34	0.45	0.02
IC1:0	0.87	0.27	0.04	0.12	0.05	0.22
GC2:1	0.85	0.28	0.10	0.10	0.09	0.19
GC3:2	0.82	0.14	0.10	0.39	0.06	0.02
GC4:3	0.82	-0.24	0.31	0.11	0.27	-0.02
GC5:4	0.69	-0.17	0.44	-0.03	0.18	-0.12
CC6:5	0.10	-0.01	0.57	0.09	0.58	0.25
MU4-2	0.14	0.18	0.65	0.47	-0.01	-0.17
MU3-3	0.36	0.06	0.10	0.73	0.15	0.39
AMDSHI	0.41	0.17	-0.06	0.72	0.25	0.07
SAMDBS	-0.05	0.01	0.76	0.24	-0.04	-0.36
PMDBLO	-0.25	0.09	0.67	0.09	0.33	-0.26
OF1CF	0.16	0.14	0.31	0.77	-0.13	-0.04
OF2CF	-0.50	0.08	0.34	0.54	0.15	0.29
OF0CF	0.26	-0.07	0.04	0.24	-0.16	0.78
Expl.Var	4.56	3.89	4.13	2.74	2.58	1.47
Prp.Totl	0.19	0.16	0.17	0.11	0.11	0.06

Legend: SHALZD – system of ‘shallow’ zone defence;
DEEPZD – system of ‘deep’ zone defence;
ZONEM – system of ‘M’ zone defence;
PRES8M – press defence at 8 meters from the goal;
PRESHC – press defence on the defensive half of the pool;
PRESWC – press defence across the whole court;
COMZ1P – system of the combined zone defence to one player;
COMZ2P – system of the combined zone defence to two players;
COMZ3P – system of the combined zone defence to three players;
COMZ4P – system of the combined zone defence to four players;
IC1:0 – individual counterattack, known as 1:0;
GC2:1 – the group counterattack 2:1;
GC3:2 – the group counterattack 3:2;
GC4:3 – the group counterattack 4:3;
GC5:4 – the group counterattack 5:4;
CC6:5 – the collective counterattack 6:5;
MU4-2 – man up 4-2;
MU3-3 – man up 3-3;
AMDSHI – active man down with shifting from one side to another;
SAMDBS – semi active man down with block and occasional shifting;
PMDBLO – passive and deep man down with blocks only;
OF1CF – system of positional offense with one centre forward;
OF2CF – system of positional offense with two centre forwards;
OF0CF – system of positional offense without a centre forward

activities with a numerical advantage, attacking activities with an equal number of players and dynamic defensive activities with a numerical handicap; (5) static-vertical defensive activities with an equal number of players; (6) extremely rare offensive activities, which explain 19%, 16%, 17%, 11%, 11%, 6% of the variability of the manifest space, respectively.

Discussion

The results of the present research confirmed that it is a reliable and valid questionnaire for determining the optimal beginning age for learning tactical skills in water polo. Furthermore, the questionnaire was successfully structured according to modelled tactical elements depending on the age of the young water polo players.

The results of the mean values indicate that the coaches probably think that it is too early to start acquiring tactical knowledge in water polo in the first year of training. In the second year of training, coaches start learning tactics in only three variables, while most of the simpler tactical solutions start to be learned in the third year of training. Most of the more complex tactical variations are only learned in the fourth and fifth year of training.

The factor named Individual and group activities with numerical advantage/disadvantage represents the first latent dimension, and it is determined by the following variables: individual counterattack, known as 1:0; the group counterattack 2:1; the group counterattack 3:2; the group counterattack 4:3; the group counterattack 5:4. The first latent dimension is responsible for 19% of the variability of the items. This latent dimension is defined by the characteristics of the variables of the simplest tactic of water polo in terms of individual and group movements with numerical advantage/disadvantage. It is plausible that the experts believed that the aforementioned variables are at the top of the hierarchical structure at the optimal start of learning the tactics of water polo. The above variables essentially provide a good basis for further training in water polo tactics.

The second latent dimension could be named as Dynamic-complex collective defensive activities with an equal number of players. The second latent dimension, which is responsible for 16% of variability of items, as being determined by variables: system of 'M' zone defence; system of the combined zone defence to one player; system of the combined zone defence to two players; system of the combined zone defence to three players; system of the combined zone defence to four players. This latent dimension is defined by the characteristic variables of zone defines with dominance of partial zone defines. The common feature of all the zone systems mentioned above is that one part of the player is in a vertical position and the other part of the player is in a horizontal position.

The third latent dimension, which is responsible for 17% of variability of items, as being determined by variables: press defence at 8 meters from the goal; press defence on the defensive half of the pool; press defence across the whole court; the collective counterattack 6:5; man up 4-2; semi active man down with block and occasional shifting; passive and deep man down with blocks only can be interpreted as Intensive defensive activities with an equal number of players, static defensive activities with a numerical handicap

and collective offensive activities with a numerical advantage. Considering the complexity of the tactical performance of the mentioned variables, the experts probably placed the mentioned variables only third in the hierarchical structure of the optimal start of learning tactical skills in water polo. The experts most likely recognised the similarity in the completion of the collective counterattack with the man up 4-2, in the variants of the man down with a pronounced block and, above all, in all three variants of pressing in the set defence phase.

The fourth latent dimension, which is responsible for 11% of variability of items, was named as a Static-vertical attacking activity with a numerical advantage, attacking activities with an equal number of players and dynamic defensive activities with a numerical handicap. The following variables mostly belong to the fourth factor: man up 4-2; man up 3-3; active man down with shifting from one side to another; system of positional offense with one centre forward; system of positional offense with two centre forwards. According to the experts, the preparation and performance of the most energy-sapping variant of the man down is probably only the fourth link in the comprehensive tactical training of young water polo players. It can be assumed that the above-mentioned performance is an integral part of the training cycle for both types of man up in water polo. In addition, positional play in attack with one and two centre forwards is considered part of the cohesive space in modern water polo.

The factor which can be named Static-vertical defensive activities with an equal number of players represents the fifth latent dimension, and it is determined by the following variables: system of 'shallow' zone defence; system of 'deep' zone defence. The fifth latent dimension is responsible for 11% of the variability of the items. This latent dimension is defined by the variables' characteristic of the most demanding defensive tactic, in which all defensive players are in a vertical position. This tactical variant requires players to have great observation skills and greater work activity, which belongs to the later age or playing age.

The sixth latent dimension could be named as Extremely rare offensive activities. The sixth latent dimension, which is responsible for 6% of variability of items, as being determined by variable: system of positional offense without a centre forward. The last latent dimension belongs to the water polo tactic, which is used extremely rarely, and it is no wonder that it is the last link in the educational cycle of water polo tactics.

This research confirms the conclusion that declarative tactical knowledge varies among young athletes at different ages (Américo et al., 2016; Matos et al., 2019). The results of this study indicate that the coaches logically believed that the tactical elements should be taught according to the didactic principles of simpler and easier to more complex and difficult (Marius-Costel, 2010; Bjelica & Bilić, 2008). By distributing tactical solutions according to complexity in four years, the possibility of injuries in young water polo players can be reduced, which is in line with the recommendations that it is very harmful to start specialization in sports early (Baker, 2003; Jayanthi et al., 2013). Apart from a higher injury rate, the risks of early sporting specialization also include increased psychological stress and giving up sport at a young age (Jayanthi et al., 2013). In general, only appropriate

periodization and methodically correct training can lead to the desired effects in young water polo players and other athletes (Hraste et al., 2016; Malina & Bouchard, 1991). As the questionnaire was completed by a sample of experienced and educated water polo coaches, it is likely that the responses were guided or at least influenced by examples of good practice, expert opinion and developmental characteristics of children (García-Angulo et al., 2019). There is a possibility that such a clearly defined tactical curriculum will provide additional motivation for young water polo players (Murillo et al., 2022).

In future research, it will be necessary to further develop a model of timely acquisition of tactical knowledge in water polo, as the acquisition and development of tactical skills in young athletes is different and non-linear, and the need for constant assessment during the training process is justified by age (de Castro Júnior et al., 2020; Praça et al., 2017). Following this research, the results could be incorporated into the training process and curricula for tactical training in water polo. Furthermore, refining these processes could help to reduce the risk of injury, increase player career longevity and promote optimal growth, development and performance.

Conclusions

The results of this research show that coaches generally agree that 24 elements of water polo tactics should be taught according to basic didactic principles, which confirms the main hypothesis of this research.

This research can inform the training plan and programme for teaching tactical skills to young water polo players.

Future research should aim to increase the number of coaches with different levels of coaching experience, playing experience and qualifications involved in this work to gain a deeper insight into the understanding and application of didactic principles in water polo.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Визначення оптимального віку для опанування тактики водного поло згідно з експертною думкою: Розуміння шляхом аналізу зниження розмірності

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 8 с., 2 табл., 29 джерел.

Історія питання. Процес підготовки юних ватерполістів має велике значення, оскільки він має бути адаптований до дидактичних принципів та особливостей розвитку спортсменів. Однак, незважаючи на важливість цього питання, спостерігається брак відповідних досліджень.

Мета дослідження. Метою дослідження було визначити та обґрунтувати відповідний вік для початку вивчення тактичних елементів у водному поло, згідно з думкою тренерів-експертів у цій галузі спорту.

Матеріали та методи. Відповідно до поставлених вище цілей, 27 тренерів-експертів з водного поло заповнили нову анкету, спеціально розроблену для проведення цього дослідження.

Результати. Показники ретестової надійності продемонстрували задовільні результати (значення R коливається в межах від 0,85 до 1,00 при $p < 0,05$ для всіх змінних). За результатами дослідницького факторного аналізу із застосуванням критерію Гутмана-Кайзера для відбору кількості факторів та методу обертання Варімакс вихідних даних встановлено наявність шести основних факторів в контексті реального життя: (1) індивідуальні та групові дії з чисельною перевагою/недостачею; (2) динамічно-комплексні колективні захисні дії з рівною кількістю гравців; (3) інтенсивні захисні дії з рівною

кількістю гравців, статичні захисні дії з чисельною меншістю та колективні атакуючі дії з чисельною перевагою; (4) статично-вертикальні атакуючі дії з чисельною перевагою, атакуючі дії з рівною кількістю гравців та динамічні захисні дії з чисельною меншістю; (5) статично-вертикальні захисні дії з рівною кількістю гравців; (6) вкрай рідкісні атакуючі дії, які пояснюють 19%, 16%, 17%, 11%, 11%, 11%, 6% варіабельності відкритого ігрового простору відповідно.

Висновки. Представлені результати дослідження підкреслюють нове розуміння експертних поглядів щодо вивчення комплексних рухів у водному поло та пропонують основні рекомендації для ключових зацікавлених сторін щодо оптимізації тренувальних процесів та навчальних програм для усіх юних гравців у водне поло.

Ключові слова: експерти з водного поло, тактичні елементи, нова методологія навчання, дидактичні принципи, рання спеціалізація.

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