

## FORMATION AND DEVELOPMENT OF PROFESSIONAL RELIABILITY OF FUTURE PHYSICAL EDUCATION TEACHERS

Oleksandr SOLTYK<sup>1</sup>, Bogdan VYNOGRADSKYI<sup>2</sup>, Yevgen PAVLYUK<sup>1</sup>, Tetyana  
CHOPYK<sup>1</sup>, Oleksandr ANTONIUK<sup>1</sup>, Oksana PAVLYUK<sup>1</sup>, Iuliia PAVLOVA<sup>2\*</sup>

<sup>1</sup> Khmelnytskyi National University, Khmelnytsky, Ukraine

<sup>2</sup> State University of Physical Culture, Ukraine

\*Corresponding author: pavlova.j.o@gmail.com

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**Abstract.** *The aim of the investigation was to check the efficiency of implementation of the defined pedagogical conditions into the educational process, namely: interdisciplinary integration within the content of professional training, improvement of physical training on the basis of the increase of the range of physical exercises, application of methods of professional reliability formation, focus of practical training on the formation of professional reliability. The future PE teachers took part in the study; the control group (CG, n = 207) and experimental group (EG, n = 205) was formed. CG studied in the traditional system, the experimental group witnessed the realisation of the aforementioned pedagogical conditions in the educational process. The cognitive component of professional reliability was checked by the availability of the system of knowledge of organization of the pedagogical process of PE; activity component was characterised by indices of verbal and functional self-devotion, general and motor density of a lesson; morphofunctional component was evaluated by the state of respiratory system, level of muscular system development. The positive dynamics of the formation of professional reliability in EG was observed. Namely, 9.27% of students from the EG showed a high level of professional reliability formation; 43.41% – average, and 47.32% – low level as opposed to students from the CG that showed levels at 0%, 18.36%, and 81.64% respectively. Comparison of the obtained results between the CG and EG revealed improvement of the results of cognitive, activity and morphofunctional components of professional reliability of students from the EG.*

**Keywords:** *students, professional development, physical education, future teachers.*

### Introduction

Analysing a physical education (PE) teacher as an important person in modern world, whose professional actions are aimed at improving the level of adaptation and functional capabilities of students' bodies, resistance to the processes of hypokinesia and hypodynamia and ensuring a healthy young generation, it should be noted a significant interest in the issue of teacher professional training quality improvement (Pavlova, Vynogradskyi, Ripak, Zikrach, & Borek, 2016; Pavlova, Stefankiv, & Vynogradskyi, 2016; Pavlyuk et al., 2019).

Undoubtedly, present-day higher education has great opportunities to organize the educational process, namely use modern information technologies and implement competence approach and innovative educational technologies. Also, constant changes that happen in society and various areas of human activity, as well as the modernisation and integration of the processes in education, require a search for new trends and improving the existing ones in future teacher training, namely PE teachers.

Formation of professional reliability of future PE teachers should be noted as one of the prospective trends of professional training quality improvement. The issue of formation of professional reliability is "worked into" the new paradigm of pedagogy. Integration of humanitarian and technical knowledge opens great opportunities for researching important pedagogical issues. The efficiency of implementing reliability features in professional activity was confirmed in various spheres, namely power engineering, military, sports, etc. Professional reliability in pedagogical activity was much less analysed (Johnson, 2013; Ling, Pihie, Asimirin, & Fooi, 2015; Parkes & Maughan, 2009; Pavlyuk et al., 2018; Shon, 2006). Professional reliability of PE teachers was analysed (Berkson et al., 2013; Johnson, 2013). However, fragmentary analysis of this issue, lack of complete and substantiated data regarding professional reliability of the PE teacher stipulate the necessity of research in this field.

### *Problem statement*

Formation of personal comprehension of professional reliability of a future PE teacher and further organization and execution of pedagogical experiment have to be preceded by a detailed analysis of the issue of reliability and its application in various domains of human activity. Significant expansion of the theoretical and practical basis of reliability was promoted by a shift of focus from analysis of the reliability of techniques and technical systems to the investigation of professional reliability of a person who plays the role of a main moderator of activity, controls the processes and ensures the functioning of various systems and objects.

Analysing a person as a super-complex, mechanical, functional and anatomical system, the physiological components involved in the execution of motor actions, the psychological component stipulated by the totality of

personal qualities and the social sphere closely related to a regulatory part can be distinguished. Given the fact that human work, professional activity depends on a complex combination of all its elements as human body's build, as well as mental regulation of its actions, reliability of a person can have different content and concern various aspects and indications of human activity.

Apart from general features that characterise professional reliability of future specialists, specific features related to peculiarities of professional activity (namely a PE teacher) have to be taken into account. Thus, further research is focused on complementarity of various branches of science in the analysis of significant aspects of the formation and development of future PE teachers.

#### *Research questions*

Analysis of formation and development of professional reliability of future PE teachers requires a consistent solution of a number of tasks. The primary task was to establish personal comprehension of professional reliability and to substantiate components and indices that characterise professional reliability. An important issue was execution of pedagogical experiment with realization of defined pedagogical conditions in educational process, namely: improvement of physical fitness of PE teachers on the basis of diversification and extension of the range of physical exercises; application of the methods of professional reliability formation; focus of practical training on formation of professional reliability; taking into account individual and psychological features within formation of professional reliability; interdisciplinary integration in the content of professional training.

#### *Purpose of the study*

The aim of the investigation was to check the efficiency of implementation of the defined pedagogical conditions into the educational process (interdisciplinary integration within the content of professional training, improvement of physical training on the basis of the increase of the range of physical exercises, application of methods of professional reliability formation, focus of practical training on the formation of professional reliability) in terms of formation of professional reliability of future PE teachers.

### **Material and Methods**

*Sample.* Students aged 19-21 (n = 412) in the 3rd and 4th years of studies from various higher educational establishments of Ukraine (Khmelnitskyi National University, Kamyanets-Podilsky Ivan Ohienko National University, Ternopil Volodymyr Hnatiuk National Pedagogical University, Drohobych Ivan Franko State Pedagogical University, Pavlo Tychyna Uman State Pedagogical University, Lesya Ukrainka Eastern European National University) whose future specialty was teacher of PE took part in the research.

*Research organization.* Control group (CG, n = 207) and experimental group (EG, n = 205) of students were formed. Implementation of pedagogical conditions in the educational process of EG lasted two years. Upon completion of the pedagogical experiment, average values of indices that characterise the level of formation of professional reliability were defined separately for CG and EG.

Unlike CG, in which students were trained by the traditional system, EG's educational process testified implementation of the program that contained totality of the developed pedagogical conditions (improvement of physical fitness on the basis of extension of the range and variety of physical exercises; application of the methods of professional reliability formation; taking into account individual and psychological features of students within formation of professional reliability; interdisciplinary integration in the content of professional training). Implementation of pedagogical conditions was done via selection, modelling of education content, application of various methods and organizational forms of studies. Each of the pedagogical conditions defined by us promoted the formation of separate components of professional reliability and had direct connections with specific indices of professional reliability.

Improvement of physical training based on increasing the number and extension of a variety of physical exercises were done on the basis of distinguishing separate practical subjects that were aimed at studying new motor exercises and improvement of motion actions execution. When studying practical subjects, it was rather important to maximally use them with the purpose of studying new physical exercises, modern types of motor activity.

Basic methods and means that guided pedagogical conditions. "Application of author's methods of formation of professional reliability" included the creation of a personal dictionary of motivational expressions; knowledge and use of clear commands; formation of the sense of student's body reaction to physical workload; formation of the sense of physical exercises duration.

Within the implementation of “Focus of practical training of students on the formation of professional reliability” condition, attention was paid to the following points: speech content analysis, defining optimal distance to students, voice strength control, verbal evaluation of motions execution, inspiration and encouragement of students; detection of unreasonable stops and time losses during a lesson, defining what causes them; detailed analysis of the lesson, finding deviations from the plan, revealing reasons of errors; attempts to have a lesson increasing the number of physical exercises, revealing exercises that positively influence on students’ emotional state; demonstration of person example of execution of physical exercises, support, assistance in execution of physical exercises to students performing poorly.

Taking into account individual and personal features of students at the formation of professional reliability, including motivational spheres during professional training was aimed at influencing on the formation of professional reliability due to the improvement of specific personal qualities of a future teacher. Extension of selection for students, increase of their responsibilities for personal decisions, the inclusion of students in solving problematic tasks, an increase of their activity and role in the educational process were done.

Interdisciplinary integration in the content of professional training of future PE teachers lied in the formation of a group of several subjects, the definition of topics and specific questions, which directly or indirectly promoted the improvement of knowledge related to professional reliability.

*Professional reliability evaluation.* Based on the developed model, the structure of professional reliability was evaluated within separate components (Cognitive, Action-related, and Morphofunctional). To assess each component, a number of indicators were chosen. The evaluation was done by each indicator; general level of formation of professional reliability was also calculated.

1. Cognitive component of professional reliability was defined by the survey. The questionnaire included 100 questions; a correct answer on each question was estimated at in 0.1 point. Questions were related to theoretical principles of medical and biological peculiarities of the development of physical qualities, an adaptation to physical workload, planning, modelling, organization, control of PE educational process. Grade 4.3-5.0 showed a high level of Cognitive component; 3.3-4.2 – average level; 3.2 and less – low level.

2. Action-related component was characterised with the help of the following indicators: the ability to use various means of PE, ability to rationally use the time for a lesson, to do tasks without mistakes, communicative skills, capacity to work with optimal functional expenses. To define each of these indicators, special scales were used (Table 1).

Table 1. *Scale of evaluation of activity component of the level of formation of professional reliability of future PE teachers*

Indicator	Average index	Low index	Average level	High level
Ability to use various means of physical education	30.1	< 24	24-36	> 36
Ability to rationally use time for a lesson	84.1	< 76	76-92.2	> 92.2
Ability to faultlessly do tasks	20.84	> 25.5	16.2-25.5	< 16.2
Communicative skills	1803	< 1494	1494-2114	> 2114
Ability to work with optimal functional expenses	33.57	< 26	26-41	> 41

To evaluate the ability to use various means of physical education, the number of types of physical exercises used by teachers during a lesson was calculated. The ability to rationally use the time for a lesson was to check with the help of a lesson’s general density index (Eq. 1). To define general density, the total value of wasted time (in seconds) was measured (a span of time during which students did not have motor activity and did not receive instructional information).

$$GD = \frac{t_2 - t_M}{t_2} * 100\% \quad (1)$$

in which – GD – general density,  $t_M$  – total wasted time during a lesson,  $t_2$  – duration of a lesson.

To evaluate the ability to faultlessly do certain tasks, each student, before the start of the lesson, prepared notes including a list of physical exercises and their duration in seconds. Lessons were videotaped. Analysing lesson videotapes, differences between lesson realisation and plan were defined. The ratio between the total duration of exercises and general duration of a lesson showed the index of faultlessness (Eq. 2). Errors also included exercises

that were not planned before, ending a lesson before the time planned. Switching the order of exercises, if it did not affect the logical structure of the lesson, was not considered an error.

$$IF = \frac{t_1}{t_2} * 100\% \quad (2)$$

in which –  $t_1$  – time that corresponds to the number of seconds equalling deviation from the lesson plan;  $t_2$  – time that equals duration of a lesson (in seconds).

Communicative skills were defined by the number of words uttered by a teacher during a lesson. To calculate the number of words, we used lesson's recorded audio.

Ability to work with optimal functional expenses was defined with the help of Sigma PC 9 monitor pulse rate monitor (heartbeat rate per lesson was analysed). Values of the difference between average heartbeat rate per lesson and heartbeat rate at rest highlighted additional functional expenses that teacher needed for the lesson.

3. Morphofunctional component of professional reliability was defined by three indices: state of muscular system development, state of the respiratory system, and the ability of the body to recover from the physical workload.

The state of muscular system development was defined with the help of muscular system development index on the basis of the correlation between two frame sizes: tense shoulder perimeter and relaxed shoulder perimeter (Eq. 3). Measurement was done using millimetre shoulder tape.

$$I = \frac{O_1 - O_2}{O_2} \cdot 100\% \quad (3)$$

in which – I – muscular system development index,  $O_1$  – perimeter of tense shoulder,  $O_2$  – perimeter of relaxed shoulder.

Results ranging from 5% to 12% indicated on the average level of muscular system development. Results over 12% indicate on a high level. Respectively results below 5% – low level.

The state of the respiratory system was defined using the Stange test (timed inspiratory capacity). This test checks the ability of a person to hold their breath at full inhalation. Holding the breath for 40-49 seconds characterises the state of the respiratory system as satisfactory, over 0 – excellent, below 40 – unsatisfactory.

The ability of a body to recover from physical workload was defined with the help of Ruffier functional test (Eq. 4). To define the state of the cardiovascular system with the help of this test, 20 squats and 3 measurements of heartbeat rate had to be done.

$$IP = \frac{4 * (P_1 + P_2 + P_3) - 200}{10} \quad (4)$$

in which – IP – Ruffier index,  $P_1$  – heartbeat rate for 15 seconds at rest,  $P_2$  – heartbeat rate for first 15 seconds at rest after workload,  $P_3$  – heartbeat rate for last 15 seconds at rest after workload.

Using norms of evaluation for individuals over 15 years of age, we defined 3 levels of cardiovascular system working capacity: high level – up to 5; average – 6-10; low – over 10.

4. Overall level of formation of professional reliability was calculated in points as a total grade obtained on the basis of 10 indicators. High value of indicator index was regarded as 1 point, average – 0, low – -1. High level by 10 indicators ranged from 4 to 10 points, average – -3 to +3, low – below -4.

*Data statistical processing.* Average values (M) and mean-square deviation ( $\sigma$ ) were defined; results before and after implementation of the experimental program were compared by Student's t-criterion. Differences were considered to be true at  $p < 0.05$ .

## Results

When characterising professional reliability, the general features that indicate the notion of reliability may be pointed out. These include, first, doing certain actions, operations, production processes that are regulated by the predefined parameters of activity or regulatory and technical documentation; second, the work is done under certain conditions that often be variable and sometimes hazardous; third, compulsory feature of reliability, which is available time span, during which certain activity is done.

The aforementioned features of professional reliability should be taken into account and incorporated into the notion of professional reliability of future PE teachers as they play the role of determinants of professional reliability. It is assumed that professional reliability of future PE teachers is an integrative characteristic of a person, which ensures his/her ability and readiness to perform complex educational and preventive professional tasks efficiently and faultlessly with optimal resource expenses under conditions of professional activity throughout a defined period of time.

Given the proposed interpretation, three components (Cognitive, Action-related, and Morphofunctional) were included in the structure of professional reliability of future PE teachers. Taking into account the specific nature of the profession of a PE teacher, understanding of medical and biological regularities of physical functions development, an adaptation of a body to physical workload are important. Knowledge of planning, modelling, organization, control of PE educational process is also required. Action-related component characterises the quality and efficiency of a future teacher's pedagogical activity. Thus, the ability of a teacher to do certain professional actions that indicate professional reliability should be evaluated on the basis of verification of individual professional skills. A number of professional skills were pointed out, namely: the ability to use various means of PE, rationally use the time for a lesson, impeccably do tasks, communicative skills, the capacity to work with optimal functional expenses.

Results of the levels of formation of professional reliability of future PE teachers from CG and EG before and after the pedagogical experiment are represented in Table 2.

The efficiency of the implementation of pedagogical conditions in educational process differed in components of professional reliability. The significant number of positive changes was observed in Cognitive and Action-related components. At the same time, the Morphofunctional component did not significantly vary for the CG and EG. Regarding the indices of professional reliability, the biggest changes were observed with ability to faultlessly do tasks. Difference from the lesson plan decreased from 40.17% to 32.31%. Ability to rationally use the time for a lesson improved significantly. The increase from 72.18% to 79.6% showed that the volume of wasted time decreased for students from EG. The rise in the number of physical exercises used by future teachers during a lesson from 25.03 to 28.41 showed an improvement in the ability to use various means of PE. The results of the Cognitive component slightly, though with a high level of validity, improved.

Compared to CG, an increase in the level of formation of professional reliability was revealed after the implementation of the interventional program in EG. Among students from EG, 6.83% showed a high level of formation of professional reliability, 35.12% – average level, 58.05% – low level as opposed to students from CG, who showed 0%, 18.36%, and 81.64% for each level respectively (Figure 1). Positive dynamics of professional reliability formation in EG has proved the effectiveness of realization of the defined pedagogical conditions.

## Discussion

When defining professional reliability, most researchers analyse only some parts and aspects of professional activity. Thus, it was analysed professional reliability together with responsibility as components of teacher's professionalism and place emphasis on the activity aspect (Shon, 2006). According to the researchers, characteristic features of professional reliability are as follows: consistent fulfilment of obligations; responsible work with documents, commitments, and tasks. Moreover, the authors consider a teacher to be reliable if he is rarely late or absent from school.

Table 2. *Professional reliability of future PE teachers*

Indicator	CG		EG		t <sup>a</sup>
	Before, M (σ)	After, M (σ)	Before, M (σ)	After, M (σ)	
Cognitive component					
Knowledge of medical and biological regularities of physical qualities development, adaptation of the body to physical workload	4.18 (0.38)	4.15 (0.38)	4.1 (0.4)	4.4 (0.4)	5.919
Knowledge of planning, modelling, organization, control of PE educational process	3.97 (0.4)	4.0 (0.4)	4.1 (0.4)	4.2 (0.3)	5.741
Action-related component					
Ability to use various means of PE	24.0	25.0	24.5	28.4	8.01

	(3.5)	(4.0)	(3.5)	(4.6)	
Ability to rationally use time for a lesson	74.4	72.2	72.7	79.6	8.724
	(7.6)	(8.1)	(6.6)	(9.1)	
Ability to faultlessly do tasks	42.1	40.2	41.2	32.3	10.053
	(6.9)	(8.0)	(6.9)	(7.9)	
Communicative skills	1384.2	1441.9	1447.8	1557.5	3.245
	(345.0)	(358.3)	(334.0)	(364.7)	
Ability to work with optimal functional expenses	59.9	60.05	61.6	59.7	0.376
	(8.2)	(8.8)	(8.3)	(8.5)	
Morphofunctional component					
Muscular system development	9.3	9.2	9.1	9.3	0.665
	(2.9)	(1.9)	(2.8)	(1.8)	
State of the respiratory system	55.4	55.1	54.5	53.7	1.4
	(10.5)	(9.8)	(10.1)	(10.8)	
Ability of the body to recover from physical workload	9.7	9.7	9.7	9.9	1.34
	(1.8)	(1.5)	(1.8)	(1.9)	

Note: <sup>a</sup> – t = 1.96 than p <.05; t = 2.58 than p < .01

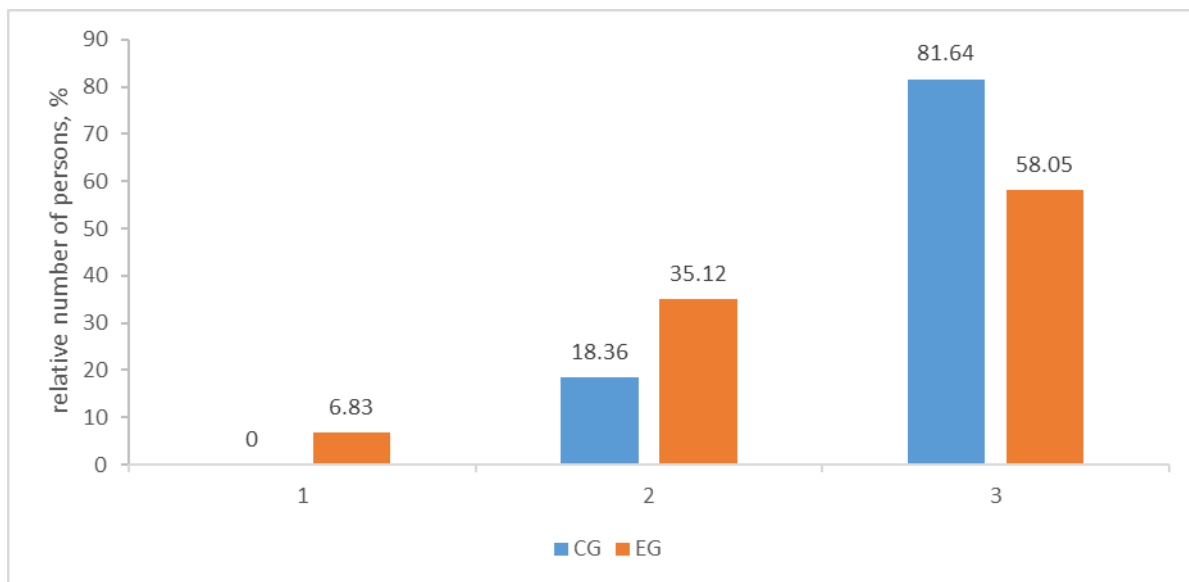


Figure 1. General level of formation of professional reliability of future PE teachers  
 1 – high level 2 – average level, 3 – low level

Professional reliability was investigated as one of five factors that help teachers gain the trust of students and parents (Blaskova, Blasko, Kozubikova, & Kozubik, 2015; Brücknerová & Novotný, 2017; Hammer et al., 2010). Along with reliability, kindness, competence, honesty, and openness are important. Moreover, the researcher associates teacher's reliability with confidence in personal and other people's thoughts. Professional reliability is characterised by the stability of personal persuasions. In addition to this, a reliable teacher need always be observant, good listener, open to other people, keep the same personality when communicating with other people.

Professional reliability was associated with a high level of teacher's efficiency, which manifests itself in teacher's efforts to teach students well and efficiently (Ling et al., 2015).

Improvement of physical training based on the increase of the range of physical exercises was aimed at improvement of the ability to use various means of PE. Application of author's methods of formation of professional reliability helped us ensure the formation of the ability to rationally use the time for a lesson and faultlessly do tasks. Interdisciplinary integration in the content of professional training was aimed at the formation of the system of understanding about medical and biological regularities of physical development, an adaptation of the body to physical workload, and consciousness of planning, modelling, organization, control of the educational process. Moreover, this pedagogical condition promoted the formation of the ability to rationally use the time for a lesson and the ability to do tasks perfectly.

Implementation of “focus of practical training in the formation of professional reliability” primarily concerned the ability to faultlessly do tasks. Moreover, during practical training, the Morphofunctional component was influenced, namely the muscular and respiratory systems, and the ability of the body to recover after the physical workload. It is assumed that the level of body fitness and state of the respiratory system, development of muscle component greatly depend on the desire of future teachers to do physical exercises, self-develop, which is primarily stipulated by a specialist’s motivational sphere.

Apart from the activity aspect, some researchers of teacher’s professional reliability emphasised on teacher’s assessment activity. Accuracy of evaluation is one of the important characteristics of a teacher’s professional reliability. Johnson (2013) notes that the accuracy of assessment was influenced by a number of factors, namely sex, social and economic status, effort and behaviour. At the same time, teachers often used verbal sets of criteria, for instance, a level description that had a certain degree of subjective interpretation. It is these circumstances that influence on inaccurate grading, which in its turn, leads to a decrease of teacher’s professional reliability. Taking into account specific nature of the professional activity of teachers of physical culture, researchers (Berkson et al., 2013) offer to shift the emphasis of grading activity on accuracy and quality of body build indices (height and weight) when defining professional reliability. Teacher’s professional reliability was defined via evaluation of physical activity in the classroom, coincidence of the results of repeated measurements being quality characteristics.

Research (Parkes & Maughan, 2009) also emphasised the importance of grading activity when defining professional reliability of a teacher. Authors associate professional reliability with the strengthening of trust to the grades, assurance of teacher’s decision quality, development of effective models of grading at various stages of education.

The ability to use various means of PE was evaluated with the help of calculation of types of physical exercises used by future PE teachers during a lesson. It was assumed that a variety of physical exercises promotes the universal and harmonious development of a student, increases interest and motivation to do physical exercises.

Being in motion during a lesson is a specific feature of the professional activity of PE teachers. A teacher must always move during a lesson, demonstrates the accuracy of performing physical exercises, helps students do certain motions, gives them support if needed. Teacher’s appearance, his physical capabilities, motions, posture are also greatly important in professional activity. In order to take these specific features of a teacher, we included the Morphofunctional component to the structure of professional reliability. This component includes state of muscular system development, state of the respiratory system, and ability of the body to recover after the physical workload.

Given these facts, improvement of personal assessment activity through completion of certain courses, trainings, and testing is an important way to improve teacher’s professional reliability (Kinyua & Okunya, 2014). It allows teachers to develop tests better, which would have a higher level of evaluation reliability and validity. Expansion of the test field, through the formulation of questions, adhering to clear instructions and standard procedures at assessment are effective means regarding the improvement of teacher’s professional reliability (Knudson, 1988).

## **Conclusion**

The research of professional reliability of future PE teachers should consider reliability characteristics and be based on the specific nature of the future activity. Along with Action-related component, knowledge, level of theoretical training and morphofunctional criteria are compulsory components of professional reliability of PE teachers. A complex combination of a number of professional skills with a high level of expert knowledge and morphofunctional state opens better possibilities for the efficient activity of future teachers and increases their resources under changing conditions of the educational environment.

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