

Empirical Analysis of the Level of Formation of Professional Reliability of a Teacher of Physical Culture

Yevgen PAVLYUK¹, Oleksandr SOLTYK², Oksana PAVLYUK³, Tetyana CHOPYK⁴, Oleksandr ANTONIUK⁵, Oleg BAZYLCHUK⁶

¹ Doctor of Pedagogy, professor of Department of Theory and Methods of Physical Education and Sport, Khmelnytskyi National University, Khmelnytsky, Ukraine, eopavlyuk@gmail.com

² Ph.D., associate professor of Department of Theory and Methods of Physical Education and Sport, Khmelnytskyi National University, Khmelnytsky, Ukraine, soltyk_sasha@i.ua

³ Ph.D., associate professor of Department of Theory and Methods of Physical Education and Sport, Khmelnytskyi National University, Khmelnytsky, Ukraine, okspavlyuk@ukr.net

⁴ Ph.D., associate professor of Department of Theory and Methods of Physical Education and Sport, Khmelnytskyi National University, Khmelnytsky, Ukraine, ratyana.chopik@ukr.net

⁵ Ph.D., associate professor of Department of Theory and Methods of Physical Education and Sport, Khmelnytskyi National University, Khmelnytsky, Ukraine, antonyuk.o@gmail.com

⁶ Doctor of Pedagogy, professor of Head of the Department of Physical Therapy and Occupational Therapy, Khmelnytskyi National University, Khmelnytsky, Ukraine, oleg.bazylchuk@gmail.com

Abstract: The article deals with the issue of professional reliability as one of modern approaches aimed at improvement of quality of professional training of teachers of physical education. The aim of research is to define and characterize the conditions of professional reliability of a teacher of physical education. Teachers of physical education from comprehensive schools took part in the experiment. Along with pedagogical observation, analysis of videos of lessons, analysis of teacher documentation (lesson plans), timing, pulsometrics, and methods of mathematical statistics have been used in the research. The results revealed empirical data that characterize indices of professional reliability, namely faultlessness, efficiency, and self-devotion of a teacher of physical education. In its turn, efficiency is determined by general and motor density of the lessons; faultlessness is determined by deviation from the lesson plan and by lesson content; self-devotion consists of verbal and functional components. Levels of indices that define formation of professional reliability of a teacher of physical culture have been revealed. Empirical analysis of the indices of professional reliability of a teacher of physical culture allowed revealing a number of features, consideration of which in professional training will enable quality improvement of training of teachers of physical culture.

Keywords: *indices of reliability; professional reliability; teacher of physical education; faultlessness; efficiency; self-devotion.*

How to cite: Pavlyuk, Y., Soltyk, O., Pavlyuk, O., Chopyk, T., Antoniuk, O., & Bazylchuk, O. (2020). Empirical Analysis of the Level of Formation of Professional Reliability of a Teacher of Physical Culture. *Revista Romaneasca pentru Educatie Multidimensionala*, 12(1Sup1), 251-266.

<https://doi.org/10.18662/rrem/12.1sup1/234>

Introduction

Training of highly-qualified staff is one of important prerequisites of efficient support of physical education and sport. This includes professional activity of a teacher of physical culture.

Despite extensive experience in the matter of physical education staff, search for new trends and ways of improvement of training of teachers of physical culture, especially under conditions of higher education reformation is urgent. These modern and perspective ways of improvement of professional training of teachers of physical culture include the formation of teacher's professional reliability. As a scientific term, reliability has long been important in scientific field, mainly in technical areas (Solytk, 2014). However, expansion of the sphere of application of reliability on one hand, and progressive development of society, production automation, informatization etc. on the other hand led to shift in emphasis from studying reliability in technical systems to analysis of reliability of a person, labor subject.

In bigger scope, human reliability became the subject of research in spheres related to production, medicine, nuclear energy, military field etc. Thus, Gertman et al. (2005), analyzed human reliability in nuclear field. Shappell & Wiegmann (2000) analyzed human reliability in aviation. Ipatova (2006) defined reliability of an operator at energy enterprises. According to scientists, reasons that have influence on human reliability include age, physical health, personality, emotions, mistakes etc. Meister (1973) relates human reliability to probability of the fact that work or task will be successfully done, a person will do all the tasks correctly, determined by the system of action for a defined time interval and will not perform any other action that will have negative impact on the system. Shcheblanov & Bobrov (1990) managed to relate the notion of reliability to psychophysical waste. In other words, in order to obtain a certain amount of a product, or perform certain production activity, a person experiences functional waste.

At the same time, the problem of definition of reliability in educational sphere can be considered as insufficiently studied. Some scientists relate teacher's reliability to personal qualities (Shon, 2006; Osadchuk, 2013; Romanova, 2014 and others). Thus, Osadchuk pays much attention to integrative feature that reflects unity of personal, subject, and individual features that provide maintaining quality of realization of pedagogical functions under changing conditions using mechanisms of self-regulation (Osadchuk, 2013). D. Romanov, 2014, relates teacher's professional reliability to durability, resistance to burnout and other negative

factors that influence on professional activity. In the paper by Shon (2006) along with responsibility, reliability is analyzed as a component of teacher's professional competence. According to the authors, a reliable teacher is the one who is rarely late or absent from school. Peculiar features of reliability are as follows: successive performance of professional duties, punctual and responsible work with documentation, duties and tasks. Other scientists (Ling et al., 2015) link reliability to high level of teacher's efficiency that is revealed in teacher's efforts to teach students more successfully and efficiently.

However, most of foreign scientists (Parkes & Maughan, 2009; Johnson, 2013 and others) pay much attention to assessment activity when analyzing teacher's reliability. Teacher's reliability is characterized by how accurate and correct teacher's grading is. Thus, Johnson (2013) notes that the accuracy of student grading is influenced by many factors that include social and economic status, efforts, and behavior. On the other hand, teachers often use verbal sets of criteria, for instance, description of a level that has certain degree of subjective interpretation. These factors influence of unequal assessment, which, in its turn, leads to decrease of teacher's reliability.

Importance of grading reliability in teacher's activity has been emphasized by Parkes & Maughan (2009). The authors relate reliability to strengthening trust to teacher's grading, provision of teacher's solutions, development of efficient models of grading at various stages of education. Other researches indicate that an important step of improvement of teacher's grading reliability is having certain training courses and learning testing systems. This enables teachers to better develop tests that have higher level of grading reliability and probability. To increase reliability of grading, other scientists propose to expand test field and pay more attention to stating tasks in a test. At the same time, attention should be paid to distinct structures and standard procedures when grading. There are also researches, which reveal that teacher's reliability depends on success of pedagogical process (Ling et al., 2015).

Having done the analysis of various definitions of a professional's reliability, we will move on to defining professional reliability of a teacher of physical culture. The formation of professional reliability of future teachers of physical culture should be preceded by a detailed analysis of reliability characteristics during his or her professional activity. Hypothesis: the study of professional reliability under real conditions of teacher's work will allow revealing characteristic features of this phenomenon, which will be further

used in the process of professional training of future teachers of physical culture.

That is why the aim of the research is to analyze and characterize indices of professional reliability of a teacher of physical culture.

The empirical analysis of indices of reliability was preceded by a detailed analysis of the issue of reliability, during which we have established terminological presentation of professional reliability of a teacher of physical culture. Thus, we consider professional reliability of a teacher of physical culture as ability of an educator to hold professional activity that is characterized by a high level of faultlessness, efficiency, and self-devotion under influence of condition of professional and pedagogical environment throughout an entire lesson of physical culture (Soltyk, 2017). Indices substantiation and formation of methodological apparatus for their study have become an important basis for further empirical study of indices of reliability.

1. Material & methods

107 teachers of physical education from secondary education establishments of Khmelnytskyi oblast (Ukraine) took part in the pedagogical experiment that lasted two years. One of the key requirements for selection of teachers of physical culture was practical experience (at least 3 years). The research was done with consent of both school administration and teachers of physical culture. Moreover, the research completely corresponded to the concept of the New Ukrainian School, according to which modern teachers are free to act, improvise and experiment. In addition, prior to the experiment all teachers were informed that the aim of the research was not to define the level of teacher's professional skills or actions. The entire research has been done on the basis of "Psychological and Pedagogical System of a Specialist's Development" R&D work of Khmelnytskyi National University.

Teachers from comprehensive schools took part in the research. The experiment was carried out under real conditions, i.e. teachers conducted lessons of physical education. At the same time, certain parameters were measured and further processed with the help of special devices according to the idea of our research.

Faultlessness was determined by two indices – deviation from the lesson plan and lesson content. Provision of accuracy, balanced planning and conducting a lesson were an obligatory condition for all teachers. All teachers were given the task to prepare a lesson plan. In the lesson plan

teachers stated the following – place and basic tasks of the lesson. Special attention was paid to the description and substantiation of exercises that were used during the lesson. Each teacher had to indicate quantitative indices of physical exercises balancing. Teachers tend to choose two systems of balancing – they indicated duration or quantity of repetitions.

Determination of the degree of deviation of actual professional actions from the planned ones was a bit difficult stage in defining faultlessness. To ensure accurate calculations, we used the following procedure. Planned duration of a lesson was 45 minutes (2700 seconds), which was 100%. Next task was to reveal general amount of seconds that constituted deviation from the plan. Further on, faultlessness was calculated by the formula 1.

$$F = t_1/t_2 \cdot 100\% \quad (1);$$

in which: t_1 – time that corresponds to the sum of seconds equal to deviation from the lesson plan;

t_2 – time that corresponds to the duration of the lesson (in seconds).

To record video of the lesson Panasonic HC-V500 video camera was used. Watching the lesson video allowed us to reveal the start, the end, actual duration of doing certain physical exercises. Hence, comparison of the lesson video with the plan allowed us to determine faultlessness, one of the indices of reliability.

It should be noted that when comparing actual lesson with the lesson plan, while determining the mistakes that corresponded to deviations from the planned lesson, we followed certain rules. Thus, new elements of physical exercises that were not listed in the lesson plan were considered as mistakes. Decrease or increase of duration of exercises, expressed both in quantitative and time values, was also considered a mistake. Interchanging the order of exercises that did not have strong impact on lesson's logic scheme was not considered a mistake. Another mistake was finishing the lesson earlier than planned. Examples of such violation were the cases when teacher ended the planned set of physical exercises earlier and had to give additional exercises till the end of the lesson, which was not stated in the lesson plan. Another type of mistake was extra-lesson time that teachers used the needed physical exercises at the expense of a break between lessons. Lesson content, another index of faultlessness, was determined by the amount of physical exercises that the teacher used during the lesson.

To calculate self-devotion, two indices were determined – the work of cardiovascular system and organs of speech. As mentioned above, the specifics of the activity of a teacher of physical culture lies in the necessity to constantly move, do the exercises, move around during the lesson, which

results in the increase of the work of cardiovascular system. The basic, most common, simple, informative and accessible index of the work of cardiovascular system is HR (heart rate).

Since, during the lesson, HR of a teacher constantly changes, we considered average value of HR_{avg} throughout the entire lesson. To define HR_{avg} during the research we used pulsometer Sigma PC 9 Man. The primary index that was measured with the help of this device was average value of heart rate throughout a certain span (in our case throughout a lesson). Taking into account that each person has individual level of physical preparedness and training condition characterized by different reactions of cardiovascular system to physical workload, for better objectivity, we did not consider HR_{avg} but the difference between HR_{avg} and HR in the state of relaxation. This helped us determine additional physical waste of a teacher of physical culture, namely the work of cardiovascular system needed to conduct a lesson.

Besides reaction of cardiovascular system to physical workload with purpose of determining self-devotion, we also determined vocal work of a teacher. This work was expressed in the number of words that the teacher pronounced during the lesson. Given the specifics of the profession of a teacher of physical culture, we added whistling and applauding to the vocal work, which were used by the teachers to give sound signals. At the same time, each separate signal was considered as a single word.

Using the calculated words and time characteristics of the lesson, apart from general number of words, we determined speech tempo (ST) by formula 2.

$$ST = k/t_2 \cdot 100\% \quad (2)$$

in which: k – number of words during a lesson; t_2 – duration of a lesson (in seconds).

Apart from general speech tempo, we additionally determined the following indices: number of words and speech tempo in various components of a lesson.

Further on, we analyzed the definition of the next index of reliability – efficiency of professional activity of a teacher of physical culture. In previous works, possibility to use motor and general density of a lesson as one of the characteristics of activity efficiency of a teacher of physical culture has been proven by Solytk (2018). For a quality definition of motor and general density, we selected a student every time before the lesson. Every time when the student stopped, time and duration of the stoppage was registered in the protocol. If a stoppage was done to give instructions, tasks to the student, or due to other pedagogical actions of the teacher, such

stoppages were considered as pedagogically-motivated and did not influence on general density of the lesson. If the student did not perform motor activity, we started another stopwatch and registered wasted time in the protocol. Two indices were calculated separately after the lesson: motor and general density. Since we registered time when the student did not do any actions, to calculate motor density (MD) we used formula 3.

$$MD = (t_2 - t_{st})/t_2 \cdot 100 \% \quad (3)$$

in which: t_{st} – overall time of student's stoppages during the lesson; t_2 – lesson duration.

General density (GD) was determined by the same principle, only the time when the student did not perform any actions and was not given any useful pedagogical information (wasted time) was taken into account (formula 4).

$$GD = (t_2 - t_m)/t_2 \cdot 100 \% \quad (4)$$

in which: t_m – overall wasted time during a lesson; t_2 – lesson duration.

When calculating motor and general density we determined percentage from the actual lesson duration. Later on, based on the obtained video materials with use of the aforementioned procedures of calculation, we calculated actual indices of professional reliability of a teacher of physical culture - faultlessness, efficiency, and self-devotion.

2. Results

The ascertaining experiment allowed revealing basic indices of reliability of a teacher of physical culture. Thus, faultlessness was determined as deviation of the lesson from the plan. As results show, the index of faultlessness varied from 9.64% to 35.93%. The average value of faultlessness was 20.84%. As data show, teachers of physical culture deviate from the lesson plan in the one fifth part of a lesson (562.7 seconds). In our research, such deviations are considered to be a mistake having negative impact on the index of faultlessness.

Further on, we will go over characteristics of the types of mistakes that influence on faultlessness. All detected deviations from the lesson plan were divided into three groups. The first group included deviations related to wrong arguing. Thus, discrepancy of arguing revealed itself in bigger or smaller amount of repetitions of exercises, longer or shorter time period for each exercise. As our calculations have shown, such type of mistakes is most common for teacher of physical culture (60.84%). The other type of

mistakes was use of exercises not stated in the lesson plan. Such type of mistakes constituted 12.68%. The third type of mistakes was related to the fact that teachers ended physical exercises earlier than planned. Such type of mistakes was observed in 26.48% of cases.

As the obtained data show, the most problematic issue in the activity of a teacher of physical culture is keeping the balancing of workload, both in number of repetitions and duration. We think that while planning and conducting lessons in physical education teachers rarely set the time for exercise duration. In general, this type of mistakes throughout a lesson constituted 342 seconds. Moreover, when conducting lessons in physical education teachers underestimate students' capabilities. This leads to decrease of workload during lessons and the number of repetitions. As a result, this also influences on general deviation from the lesson plan.

A significantly lower rate of deviation was related to the mistakes of the second type. As the results of calculations show, an average of 71 seconds was needed for the exercises not stated in the lesson plan. This proves that teachers of physical education remember to use the exercises well. Thus, in the process of professional activity, teachers of physical education have elaborated schemes of lessons and stick to certain sequence of exercises. Throughout long professional activity, teachers develop their personal style of activity that they constantly improve. Rare cases of exercises interchange have been observed.

At the same time, noting a slight percentage of mistakes of the second type compared to the mistakes related to balancing, we can reveal a negative side of activity of a teacher of physical culture. Thus, in the process of professional activity of a teacher of physical culture we may see a certain pattern of education with underestimation of students' physical capabilities. In other words, teachers of physical culture impose their own set of exercises. At the same time, students' interests is not considered. This tendency is observed in activity of teachers of physical culture. Thus, most of teachers do little changes in their individual style of teaching throughout professional career; do not work sufficiently to improve their methodological apparatus of teaching physical education and motor skills.

Next, we'll analyze mistakes of the third type, namely teachers ending the lesson earlier. To fill in the free time teachers sometimes used new exercises, which we didn't refer to the second type as they were of coerced character. Average deviation from the lesson duration constituted 149 seconds (2 mins. 29 sec.).

Further on, we will characterize lesson content. As the obtained data showed, the number of exercises used by teachers during a lesson

significantly varied from 9 to 46. The average number of exercises was 30.14. Compared to general duration of a lesson, each exercise took around 1 min. 30 sec.

The next index of reliability is efficiency of a teacher of physical culture that was determined by two indices (motor and general density) in our research. With the help of mathematical analysis we have found average values of motor density that constituted 61.26%. This index varied from 29.06% to 83.26%. General density varied from 44.53% to 99.28%. The average value of general density constituted 84.1% in activity of a teacher of physical culture.

Now, let us analyze their characteristics in detail. By the value of motor density we can find out what was the motor mode of students during the lesson, how useful the lesson was from physical workload perspective. By the values of motor density we can indirectly talk about successfulness of dealing with health-improving orientation of a lesson. At the same time, in the process of physical education, dealing with educational component is also important. Thus, students must not only do motor activities but also obtain new knowledge from the subject, learn new elements of physical exercises, master the rules of health control and self-control etc. To do this, a teacher must efficiently use certain time during a lesson to provide students with new educational information, explanation, presentation of physical exercises, control of students' condition, checking the level of physical capabilities, assessment of performance etc. In connection with this, an important role is played by the index of general density of a lesson.

At the next stage of our research we tried to find out how typical reasons or factors influenced on general density of a lesson. To do this we used videos of the lessons in physical education. The videos allowed us to reveal typical parts of a lesson when students did not have any physical workload and, at the same, did not obtain useful information. The most frequent cases were as follows: waiting for your turn, approach to start exercises or passive rest between exercises. Often students had a break during a lesson related to sports equipment. The reason for that is unpreparedness to lessons, insufficient quantity of equipment, it's bad placement etc. There were also cases when students did not do physical exercises, teachers were observing them passively or doing other actions not related to educational process.

When analyzing decrease of the level of general density of a lesson we can point out three factors. The first one is related to material base, sports equipment and inventory. The third factor is caused by teacher's

insufficient level of methodological apparatus. The third factor is related to low competence and professional level of teachers.

Another index of reliability of a teacher of physical culture is self-devotion. Given the specifics of the profession of a teacher of physical culture, we have pointed out two components: verbal and functional. Verbal component primarily characterizes the profession of a teacher of physical culture as a subject of pedagogical process, whose activity is aimed at providing students with knowledge. The basic mechanism of giving information is teacher's verbal apparatus with a word being the primary tool.

As mathematical calculations show, average amount of words uttered by a teacher during a lesson is 1804. Average tempo of utterance is 6681 words per 10 seconds. Further on, we will analyze the work of organs of speech during a lesson. By the generally acknowledged lesson plans, all lessons are divided into three parts: preparatory, basic, and final. Given different duration of these parts with different teachers, the analysis of tempo of utterance will be more informative than the analysis of words uttered. This means we consider the ratio of words in a certain period of time. Thus, teacher's tempo of speech at different stages of a lesson (preparatory, basic, and final) has been calculated. Average value of speech tempo of all teachers at the preliminary stage is 7.57 words; at basic stage – 6.27; at final stage – 8.37 words per 10 seconds.

As data show, final stage is the most productive in terms of the work of organs of speech. This index is related to short duration of the final stage, summing up activities, and giving home tasks. Slightly lower tempo of teacher's speech has been observed at the preparatory stage, during which teacher marks all present students, announces the tasks of the lesson, and does preparatory exercises. Basic stage has the lowest tempo of speech. This representation of teacher's speech work to some extent corresponds to the indices of student's physiological curve during a lesson. According to regularities of students' physical development, the beginning and final parts of a lesson should have the lowest values of heart rate. Basic stage of a lesson carries the biggest share of the work of cardiovascular system. Increase of teacher's verbal component leads to decrease of student's motor activity, which is reflected in the values of heart rate. Often, students stand still when receiving explanations, tasks, or during summing up activities.

Now, we will analyze functional component of teacher's self-devotion. As mentioned earlier, one of the important features of the profession of a teacher of physical culture is the need of maintaining consistent level of physical preparedness that enables professional activity. The direct index that characterizes functional work of teacher's body is heart

rate. The average value of HR of teachers of physical culture during lessons was 100.93 beats per minute varying from 66 to 148 beats. Without considering values in the state of rest, the increase of HR was 11 to 64 beats per 1 minute. Average value of physiological cost is 33.57 beats per 1 minute. After converting the number of beats per minute in relation to duration of a lesson, the value of additional activity of cardiovascular system that enabled teachers of physical culture to act was 1510.65 heart beats.

Average values by each index that characterizes the level of formation of professional reliability of a teacher of physical culture are the theoretical novelty of our research; however, they do not enable wide-range practical application. Defining the levels of formation of the aforementioned indices bears a more significant interest. Available numeric intervals by each index will further allow every teacher of physical culture to define personal level of formation of professional reliability, reveal lagging aspects, and set effective actions for its increase. To define the levels of manifestation, we use the method of sigma deviations. Based on this method, all values that range from $(X_{avg} - \sigma)$ to $(X_{avg} + \sigma)$ belong to average values (in which σ – is average quadratic deviation, X_{avg} – average value). Values above the interval indicated on high level of index manifestation. Respectively, lower values signified lower level (see table 1).

Table 1. Values of the levels of formation of professional reliability of future teachers of physical culture

Index	Average value	σ	Low level	Medium level	High level
Verbal self-devotion (number of words)	1804	309,8	<1494	[1494-2114]	>2114
Functional self-devotion (Δ HR avg.)	33,57	7,4	<26	[26-41]	>41
Motor density of a lesson (%)	61,3	8,18	<50	[50-60]	>60
General density of a lesson (%)	84,1	8,11	<76	[76-92,2]	>92,2
Lesson's content (number of exercises)	30,1	5,76	<24	[24-36]	>36
Deviation from the lesson plan (%)	20,84	4,69	>25,5	[16,2-25,5]	<16,2

Mathematical processing of the results of research allowed us to calculate intervals of low, medium, and high levels for each index that

characterize professional reliability of a teacher of physical culture. It should be noted that despite other indices of professional reliability, intervals of the index of motor density were calculated for a lesson of physical culture that has complex character. That is, it comprises educational and training orientation. Based on this, high level (or optimal level) of students' motor activity must be 60-70 % of the lesson. Medium level has been defined as 50-60 %. Results under 50 % indicate on low level of this index.

3. Discussions

Systematization of scientific approaches, analysis of practical experience of training and professional activity of teachers of physical culture enabled us to single out essence characteristics of professional reliability of teachers of physical culture.

Application of the method of sigma deviations allowed elaboration of the evaluation scale of indices of the level of formation of physical culture teachers' professional reliability. In the sphere of physical culture, results of the research improve content of professional training of undergraduate students (specialty 014.11 "Secondary education (Physical culture)") on the basis of diagnostics toolset and the scale of indices evaluation that characterize the level of formation of professional reliability of teachers of physical culture. This establishes broad opportunities for application of the obtained data in practical activity; namely it allows diagnostics of the state of formation of physical culture teachers' professional reliability in the process of professional training.

The experiment helped us reveal new data related to professional reliability of a teacher of physical culture. Further on, we will discuss the obtained results with view of the results of researches by other scientists. Given that professional activity of a teacher of physical culture was characterized by faultlessness, efficiency, and self-devotion, the obtained results are more or less related to many other researches.

Like Gertman et al. (2005) and Shappell & Wiegmann (2000), who relate human reliability to mistakes, we consider faultlessness as one of the indices of reliability of a teacher of physical culture. At the same time, we considered faultlessness by two separate indices: deviation from the lesson plan and lesson content.

Considering researches by Shcheblanov & Bobrov (1990) who analyze reliability through personal waste while performing professional activity, our research complements this idea to some extent. However, besides psycho physiological waste, we have determined verbal and

functional waste that presented teacher's self-devotion. Verbal self-devotion had bigger relation to pedagogical activity. In its turn, functional self-devotion incorporated specifics of the profession of a teacher of physical education.

It should be noted that our research of professional reliability of a teacher of physical education is close by its content to the one by Osadchuk (2013). At the same time, despite the quality of realization of pedagogical solutions that lie in the basis of teacher's reliability definition, we have made stronger emphasis on professional activity of a teacher of physical culture. Similar to the definition of teacher's reliability by D. Romanov, 2014, according to whom reliability means durability, resistance to emotional burnout and other negative factors, reliability of a teacher of physical culture is also influenced by changeable conditions of professional and pedagogical environment. However, content and character of professional and pedagogical environment of a teacher of physical culture drastically differs from external conditions of other pedagogical professions.

The obtained results complement data by Ling et al., (2015) according to whom reliability of a teacher is related to efficiency and successfulness of educational activity. At the same time, when characterizing professional reliability of a teacher of physical culture and defining efficiency the emphasis has been made on determining general and motor density. The given indices indicate educational and health-improving components of pedagogical activity are more specific of the profession of a teacher of physical culture.

We consider analysis of teacher's reliability through accuracy and invalidity of students' performance assessment, as presented in works (Parkes & Maughan, 2009; Johnson, 2013) insufficient, as the emphasis is primarily made on the students. However, in this case, activity of a teacher, namely his self-devotion, is not taken into account.

Similar to works by Meister (1973), Swain & Guttmann (1983), according to which reliability is defined by probability of performing tasks and professional actions; we consider reliability of a teacher of physical culture to be stipulated by performing a certain activity. Thus, a teacher of physical culture offers students various physical exercises that define lesson content.

Similar to Shon (2006) who considers reliability as a component of teacher's professionalism, the quality of professional activity of a teacher of physical culture expressed through faultlessness, efficiency, and self-devotion also characterizes teacher's professionalism. We also agree with L. Ipatova's view on reliability, according to which reliability is stipulated by the

quality of education. Obviously, big amount of exercises that a teacher has, accurate and correct conducting of a lesson in accordance with the lesson plan, skillful organization of the lesson that promotes better outcomes of motor and general density cannot be executed without respectful quality professional training of a teacher of physical culture.

Finishing discussion of the issue of professional reliability of a teacher of physical culture we can note one important achievement of this paper. The obtained quantitative characteristics allowed revealing certain drawbacks in the process of activity of a teacher of physical culture. In its turn, empirical data can be used with purpose of improving the quality of professional training of future teachers of physical culture.

4. Conclusions

We consider the analysis of professional reliability as a new trend on the way to provision of professional training of teachers of physical culture.

Empirical data of the indices of professional reliability of a teacher of physical culture have been determined: faultlessness, efficiency, and self-devotion. Deviation from the lesson plan varied from 9.64% to 35.93%; the average value was 20.84% that characterizes the index of faultlessness. Another value of faultlessness, lesson content, constitutes 9 to 46 exercises. At the same time the average number of exercises was 30.14. The index of motor density varied from 29.06% to 83.26% with average value of 1.26%. General density varied from 44.53% to 99.28%. The average value of general density in the activity of a teacher of physical culture constituted 84.1%. The average number of words uttered by a teacher during a lesson was 1804. Average speech tempo during a lesson (45 minutes) was 6681 words per 10 seconds. Functional waste (increase of frequency of heart rate relatively to the state of rest) was 11 to 64 beats per 1 minute. The average value of physiological cost was 33.57 beats per 1 minute, or 1510.65 heart beats per lesson.

The empirical analysis of indices of professional reliability of teachers of physical culture allowed revealing a number of peculiar features, consideration of which in professional training will allow quality improvement of the level of training of future teachers of physical culture. Intervals of the levels of manifestation of indices that characterize the level of formation of professional reliability of a teacher of physical culture have been defined.

References

- Parkes, C., Maughan, S. (2009). *Methods for Ensuring Reliability of Teacher Assessments*. National Foundation for Educational Research Chartered Institute of Educational Assessors. <https://files.eric.ed.gov/fulltext/ED511380.pdf>
- Gertman, D., Blackman, H., Marble, J., Byers, J., Smith, C. (2005). *The SPAR-H human reliability analysis method*. NUREG/CR-6883. Idaho National Laboratory, prepared for U. S. Nuclear Regulatory Commission. <https://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6883/cr6883.pdf>
- Ipatova, L. F. (2006). *Social'no-psihologicheskoe obespechenie nadezhnosti dejatel'nosti operativnogo personala na jenergo-predpriyatijah* [Socio-psychological support reliability of operational staff at energy enterprises]. (Candidate's thesis), Yaroslavl. <https://core.ac.uk/download/pdf/14715774.pdf>
- Meister, D. (1973). A critical review of human performance reliability predictive methods. *IEEE Transactions on Reliability*, 22(3), pp. 116-123. <https://ieeexplore.ieee.org/abstract/document/5215925>
- Osadchuk, O. L. (2013) Vzaimosvjaz' professional'noj nadezhnosti i professionalizma pedagoga [Interrelation of professional reliability and professionalism of the teacher]. *Professional Education in Russia and abroad*, 1 (9), pp. 25-31 <https://cyberleninka.ru/article/n/vzaimosvyaz-professionalnoy-nadezhnosti-i-professionalizma-pedagoga/viewer>
- Romanova, D.A. (2014). Professionalnaja nadjozhnost pedagoga [Teacher's professional reliability]. *Nauka. Obrazovanie. Tehnologii*, 2, pp. 83-85. <http://id-yug.com/images/id-yug/SET/2014/2/Romanov-Guseva-Potemina-Evmenenko-Litvinuk-2014-2.pdf>
- Johnson, S. (2013). On the reliability of high-stakes teacher assessment, *Research Papers in Education*, 28(1), 91-105, DOI: [10.1080/02671522.2012.754229](https://doi.org/10.1080/02671522.2012.754229)
- Shappell, S., Wiegmann, D. (2000). *The human factors analysis and classification system - HFACS*. DOT/FAA/AM-00/7, Office of Aviation Medicine, Federal Aviation Administration, Department of Transportation. https://www.nifc.gov/fireInfo/fireInfo_documents/humanfactors_classA_nly.pdf
- Shcheblanov, V.Yu., Bobrov, A. F. (1990). Nadezhnost' dejatel'nosti cheloveka v avtomatizirovannyh sistemah i ee kolichestvennaja ocenka [Reliability of human activity in automated systems and its quantitative evaluation]. *Psikhologicheskij žurnal*, 2, pp. 36-40. <https://www.elibrary.ru/item.asp?id=21463525>
- Shon, C. K. (2006). Teacher Professionalism. *Faculty Publications and Presentations*. Paper 46. https://digitalcommons.liberty.edu/educ_fac_pubs/46/

- Soltyk, A. A. (2017). Vyznachennia j obgruntuvannia komponentiv, kryteriiv ta pokaznykiv profesijnoi nadijnosti vchytelia fizychnoi kul'tury [Identification and justification of components, criteria and indicators of professional reliability of physical education teacher]. *Obrii*, 2(45), pp.74-80.
https://www.ippo.if.ua/images/stories/Obrii_2013/obrii_2.2017.pdf
- Soltyk, A. A. (2018). Problema profesijnoi nadijnosti fakhivtsia u naukovomu dyskursi [The problem of professional reliability of a specialist in scientific discourse]. *Suchasni informatsijni tekhnologii ta innovatsijni metodyky navchannia u pidbotovtsi fakhivtsiv: metodolohiia, teoriia, dosvid, problem*, 52, pp. 397–401.
<https://vspu.net/sit/index.php/sit/article/view/536>
- Soltyk, A. A. (2014). Psihologija profesionalnoj nadezhnosti prepodavatelja fizicheskogo vospitaniia: strategija i puti ee realizacii [Psychology of the professional reliability of the physical education teacher: strategies and ways of its realization]. *Uchenyiezapiski universiteta imeni P.F. Lesgafta*, 107(1), pp. 102–107. <http://lesgaft-notes.spb.ru/files/1-107-2014/p162-167.pdf>
- Swain, A. D., Guttman, H.E. (1983). *Handbook of human reliability analysis with emphasis on nuclear power plant application*. Washington, Dc: US. Nuclear Regulatory Commission.
- Ling, T. P., Pihie, Z. A. L., Asimirin, S., & Fooi, F. S. (2015). The validity and reliability of teacher efficacy revisited in Malaysia secondary schools. *Journal of Studies in Education*, 5(1), 27-35. DOI:
<http://dx.doi.org/10.5296/jse.v5i1.6802>