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DIDACTICS: METHODOLOGICAL APPROACHES TO DETERMINING THE CONTENT OF PHYSICAL EDUCATION TEACHER TRAINING

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Abstract

The objective of the study was to develop methodological approaches to determining the content of physical education teacher training.

Materials and methods. The study involved 62 students of the School of Physical Education, who studied according to the 2001-2005 curriculum. To solve the tasks set, the study used both philosophical and general scientific research methods, including: dialectical method (principle of historicism, principle of systematicity, principle of dialectical contradiction, principle of unity of quality and quantity, principle of dialectical negation, principle of development, principle of causality); systems approach; factor and discriminant analysis.

Results. The results of performance analysis show an average level of proficiency in learning material. By the coefficient of variation, the grades in History of Modern World, Culturology, Gymnastics, TMPE, 3rd year vary considerably (>33%). The students' performance in Therapeutic Physical Training, Fundamentals of Ecology, Thesis has an average level of variability. By most indicators, the students are assessed as a homogeneous group. The analysis of similarities (h2) showed that the most informative indicators of the quality of students' training are the grades in the following subjects: Teaching Practice (middle school) (0.817); Biomechanics (0.772); Qualification Examination (0.764); Teaching Practice (senior school) (0.763).

Conclusions. Factor and discriminant analysis provided objective information on the quality of physical education teacher training. The results of factor analysis do not confirm the objectivity of empirical identification of four groups of academic subjects of the curriculum.

The factor structure of the curriculum indicates the need to change the content of education, aimed at improving the training of highly qualified teachers. The training of a physical education teacher should include the following blocks of subjects: professional theoretical and practical training, natural sciences, theory and methods of physical education of schoolchildren, special training in the chosen sport. The results of discriminant analysis show that physical education teacher training is aimed at developing knowledge, abilities and skills in the sections: 1) Means and Methods of Physical Education; 2) Theory and Methods of Motor Abilities Development; 3) Theory and Methods of Teaching Motor Actions.

Keywords: physical education teacher, content of training, factor analysis, discriminant analysis.

Introduction

A characteristic feature of the improvement of physical education in Ukraine is constant expansion of curricula and programs, introduction of new subjects, increase in the number of hours for humanitarian and socio-economic training. The adaptation of the field to European standards has created a situation where students of different years of study are taught according to different curricula, which are continually edited.

The methodology of studying the content of higher education was discussed in the papers by Perez-Encinas Adriana and Rodriguez-Pomeda Jesus (2018), Vukasovic Martina (2019), Liu Xiqian, and Borden Victor (2019). The prospects for the development of higher education from the standpoint of globalization and differentiation in higher education systems of different countries were studied by van Vught Frans A., van der Wende Marijk C., and Westerheijden Don F. (2018).

Modern research has considered the problem of professional training of physical education teachers (Muszkieta,

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Napierała, Cieślicka, Zukow, Kozina, Iermakov, & Górny, 2019a; Muszkieta, Napierała, Zukow, Cieślicka, Iermakov, & Kozina, 2019b), formation of competencies and motivation (Popovych, Zavatskyi, Tsiuniak, Nosov, Zinchenko, Mateichuk, Zavatskyi, & Blynova, 2020; Prystupa, Kryshatanovych, Danylevych, Lapychak, Kryshatanovych, Sikorskyi, Podolyak, & Basarab, 2020; Richards & Levesque-Bristol, 2014); psychophysiological readiness for professional work (Kokun, Imas, Vovkohon, Potop, Korobeynikov, G., Ko-

robeynikova, L., Gorashchenko, & Polevaya-Secaryanu, 2018; Koh, Ong, & Camiré, 2016).

In the XX century, curricula in Ukraine were modernized through the introduction of state standards for a period specified by law. The standards established a single normative and substantive basis for training specialists (Kravchuk, 2006, 2008). The analysis of archival materials revealed the trends in curricula changes, the basis of which is the balance of time allotted for general, pedagogical, and special training. Allocating 60% of time

Table 1. The results of student performance for the period 2001-2005

No.	Subjects	X	S	V	As	Ex
Cycle of humanitarian and socio-economic training						
1	History of Modern World	6.768	2.359	34,86	0.048	-0.763
2	History of Ukraine	7.087	2.201	31,06	0.024	-1.062
3	Political Science	7.899	1.467	18,57	0.176	-1.127
4	Sociology	7.290	1.767	24,24	0.004	0.962
5	Culturology	6.087	2.195	36,06	0.072	-0.710
6	Philosophy	7.681	1.649	21,47	0.069	-0.357
7	Fundamentals of Economics	6.899	2.059	29,84	-0.005	-1.051
8	Fundamentals of Law	9.116	2.019	22,15	-0.071	-0.460
9	Business Ukrainian Language	8.087	1.861	23,01	-0.119	-0.354
10	Foreign Language	7.246	1.826	25,2	0.090	-0.614
Cycle of natural sciences training						
11	Anatomy	8.043	1.702	21,16	-0.003	-1.135
12	Anatomy	7.348	1.969	26,8	0.046	-0.951
13	Biochemistry	6.406	2.002	31,25	0.084	-0.330
14	Biomechanics	7.174	2.155	30,04	0.034	-1.061
15	Fundamentals of Ecology	10.014	1.500	14,98	-0.454	2.250
16	Hygiene	7.377	1.699	23,03	-0.012	-0.600
17	General Physiology	7.377	1.750	23,72	0.008	-0.834
18	Sports Physiology	7.609	1.873	24,62	-0.021	-1.115
19	Therapeutic Physical Training	8.652	1.464	16,92	0.008	-1.068
Cycle of psychological and pedagogical training						
20	History of Pedagogy	7.217	1.909	26,45	0.044	-1.019
21	General Pedagogy	8.072	1.897	23,5	-0.016	-0.801
22	Course Paper in Pedagogy	7.913	1.788	22,6	0.001	-0.839
23	General Psychology	8.072	2.089	25,88	-0.040	-1.040
24	Age and Pedagogical Psychology	7.217	1.635	22,65	0.041	-0.660
25	Social Pedagogy	7.536	2.076	27,55	0.029	-1.056
26	Course Paper in Social Pedagogy	8.072	1.897	23,5	0.012	-1.134
Cycle of professional training						
27	Sports and Pedagogical Improvement, 2nd year	8.884	1.558	17,54	0.033	-0.905
28	TMPE, 2nd year	7.246	1.826	25,2	0.019	-0.786
29	Swimming	7.377	1.476	20,01	0.209	-0.866
30	Skiing	8.290	1.486	17,93	-0.090	-0.766
31	Track-and-Field Athletics	8.580	1.547	18,03	-0.012	-1.234
32	Gymnastics	7.783	2.743	35,24	0.003	-1.345
33	Sports Games	8.348	1.670	20	-0.015	-0.114
34	TMPE, 3rd year	7.536	2.564	34,02	0.012	-1.248
35	Course Paper in TMPE	7.435	1.989	26,75	0.014	-0.876
36	Course Paper in Specialty	9.522	1.357	14,25	0.010	-0.634
37	Sports and Pedagogical Improvement, 4th year	9.174	1.372	14,96	-0.125	-0.465
38	Teaching Practice (middle school)	8.348	2.549	30,53	-0.006	-1.241
39	Teaching Practice in Children's Health Camps	8.609	1.784	20,72	-0.103	-0.019
40	Teaching Practice (senior school)	8.319	2.193	26,36	-0.029	-0.746
41	Qualification Examination	8.319	1.761	21,17	0.057	-0.945
42	Thesis	9.101	1.742	19,14	-0.030	-0.625

Table 2. The structure of professional training of a physical education teacher. Factor matrix after rotation (specified loads > |0.30| (n =62)

No.	Subjects	Factors				h ²
		1	2	3	4	
1	History of Modern World		-0.579			0.451
2	History of Ukraine		-0.813			0.763
3	Political Science	0.507	-0.334	0.370	-0.473	0.729
4	Sociology	0.473		0.412		0.547
5	Culturology	0.353	-0.532			0.528
6	Philosophy	0.682		0.335		0.646
7	Fundamentals of Economics		-0.343			0.281
8	Fundamentals of Law		-0.326	0.604		0.525
9	Business Ukrainian Language			0.576		0.526
10	Foreign Language	0.435	-0.488		-0.332	0.562
11	Anatomy		-0.629	0.388	-0.306	0.645
12	Anatomy		-0.745			0.702
13	Biochemistry	0.367	-0.746			0.729
14	Biomechanics	0.302	-0.790			0.772
15	Fundamentals of Ecology			0.470		0.364
16	Hygiene	0.524	-0.408	0.453		0.647
17	General Physiology	0.461	-0.505	0.306	-0.396	0.718
18	Sports Physiology	0.430		0.582		0.669
19	Therapeutic Physical Training	0.638				0.597
20	History of Pedagogy		-0.711			0.588
21	General Pedagogy	0.410		0.302	-0.503	0.567
22	Course Paper in Pedagogy	0.451		0.356	-0.387	0.530
23	General Psychology	0.587	-0.368			0.569
24	Age and Pedagogical Psychology	0.584	-0.348	0.442		0.712
25	Social Pedagogy	0.622	-0.360	0.376		0.676
26	Course Paper in Social Pedagogy	0.518		0.450		0.559
27	Sports and Pedagogical Improvement, 2nd year		-0.442	0.433		0.495
28	TMPE, 2nd year	0.647			-0.360	0.617
29	Swimming	0.645		0.343		0.661
30	Skiing		-0.300	0.597	-0.355	0.654
31	Track-and-Field Athletics	0.629		0.301	-0.393	0.683
32	Gymnastics	0.571	-0.348		-0.309	0.631
33	Sports Games		-0.411		-0.665	0.734
34	TMPE, 3rd year			0.760		0.716
35	Course Paper in TMPE			0.646		0.554
36	Course Paper in Specialty				-0.817	0.749
37	Sports and Pedagogical Improvement, 4th year				-0.744	0.718
38	Teaching Practice (middle school)			0.851		0.817
39	Teaching Practice in Children's Health Camps	0.554				0.406
40	Teaching Practice (senior school)	0.696			-0.444	0.763
41	Qualification Examination	0.669	-0.321	0.360		0.764
42	Thesis		-0.305		-0.694	0.707
	%	30.800	26.462	24.294	18.444	62.55

for special training ensured quality training of specialists (Kravchuk, 2006). However, studies did not analyze the effectiveness of curricula by the level of students' knowledge, did not determine the curriculum structure based on multidimensional statistics.

The objective of the study was to develop methodological approaches to determining the content of physical education teacher training.

Materials and methods

Study participants

The study involved 62 students of the School of Physical Education, who studied according to the 2001-2005 curriculum.

Study organization

To solve the tasks set, the study used both philosophical and general scientific research methods, including: dialectical method (principle of historicism, principle of systematicity, principle of dialectical contradiction, principle of unity of quality and quantity, principle of dialectical negation, principle of development, principle of causality); systems approach; factor and discriminant analysis. The analysis was carried out based on subjects with an exam as the form of knowledge control.

Statistical analysis

The study materials were processed using IBM SPSS 20 statistical analysis software. Factor analysis was performed. In the factor analysis, the study used the model of principal components with the rotation method: Varimax with Kaiser Normalization.

For each canonical discriminant function, the study calculated: eigenvalue, dispersion percentage, canonical correlation, Wilks' Lambda, Chi-square.

Results

The analysis of the curriculum for training specialists has shown that it is divided into four groups of subjects:

- I. Cycle of humanitarian and socio-economic training (10 subjects).
- II. Cycle of natural sciences training (9 subjects).
- III. Cycle of psychological and pedagogical training (5 subjects).
- IV. Cycle of professional training (9 subjects).

Cycle I includes 30.3%, Cycle II – 27.27%, Cycle III – 15.5%, Cycle IV – 27.27% of the subjects. This ratio of basic subjects in the curriculum shows a decrease in the number of hours for special training compared to humanitarian and general pedagogical training.

The results of performance analysis are given in Table 1 and indicate an average level of proficiency in learning material. By the coefficient of variation, the grades in History of Modern World, Culturology, Gymnastics, TMPE, 3rd year vary considerably (>33%). The students' performance in Therapeutic Physical Training, Fundamentals of Ecology, Thesis has an average level of variability. By most indicators, the students are assessed as a homogeneous group.

Factor analysis identified four factors, which explain the variation of total dispersion by 62.55% (Table 2).

The first factor explains the variation of total dispersion by 30.8%. With the first factor, the highest correlation is in the performance of the following subjects: Teaching Practice (senior school) (0.696), Philosophy (0.682), Qualification Examination on TMPE (0.669), General Principles of Theory and Methods of Physical Education (0.647), Swimming (0.645), Therapeutic Physical Training (0.638), Track-and-Field Athletics (0.629).

The factor characterizes practical and theoretical competence of graduates. The factor is called the Cycle of Theory and Methods of Physical Education and Sports Subjects.

The second factor explains the variation of total dispersion by 26.462%. With the factor, the highest correlation is in the performance of the following subjects: History of Ukraine

(-0.813), Biomechanics (-0.790), Biochemistry (-0.746), Anatomy (-0.745), History of Pedagogy (-0.711). The factor is interpreted as a cycle of natural sciences.

The third factor explains the variation of total dispersion by 24.294%. With the factor, the highest correlation is in the performance of the following subjects: Teaching Practice (middle school) (0.851), Theory and Methods of Physical Education (0.760), Course Paper in TMPE (0.646). The factor is interpreted as Theory and Methods of Physical Education of Schoolchildren.

The fourth factor explains the variation of total dispersion by 18.444%. With the factor, the highest correlation is in the performance of the following subjects: Course Paper in Specialty (-0.817), Sports and Pedagogical Improvement (-0.744), Thesis (-0.694). The factor is interpreted as special training in the chosen sport.

Thus, the results of factor analysis do not confirm the objectivity of empirical identification of four groups of academic subjects. The factor structure of the curriculum indicates the need to change the content of education, aimed at improving the training of highly qualified teachers.

The analysis of similarities (h^2) showed that the most informative indicators of the quality of students' training are the grades in the following subjects:

- Teaching Practice (middle school) (0.817);
- Biomechanics (0.772);
- Qualification Examination (0.764);
- Teaching Practice (senior school) (0.763).

Since in the first factor the grade in Qualification Examination on TMPE (0.669) and General Principles of Theory and Methods of Physical Education (0.647) had the greatest weight, the study performed a discriminant analysis of the results of modular control in General Principles of Theory and Methods of Physical Education (Tables 3-6). The obtained testing results show an average level of proficiency in learning material (Table 3).

Table 3. The results of modular control in General Principles of Theory and Methods of Physical Education (grade according to a 100-point scale)

No.	Topic	Mean	S	N
1.1	Introduction to TMPE	77.02	15.21	62
1.2	PE as a Social Phenomenon	67.34	21.13	62
2.1	Physical Exercises	74.6	17.68	62
2.2	Technique of Physical Exercises	75.4	14.43	62
2.3	Classification of Physical Exercises	78.89	14.21	62
2.4	Exercise and rest	77.42	21.19	62
2.5	Methods of Physical Education	84.28	17.47	62
3.1	Biological, Psychological and Pedagogical Patterns of Motor Activity	74.06	17.47	62
3.2	Agility	74.46	14.14	62
3.3	Movement Coordination	80.78	16.08	62
3.4	Strength Abilities	83.87	9.99	62
3.5	Motor Endurance	81.58	14.56	62
3.6	Flexibility	77.68	10.85	62
4.1	Theoretical Principles of Teaching Physical Exercises	81.45	17.16	62
4.2	Characteristics of Teaching Motor Actions	80.24	17.15	62
4.3	Techniques of Teaching Motor Actions	76.74	11.98	62

Table 4. Canonical discriminant function. Eigenvalues.

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	3351.623	71.1	71.1	.980
2	1358.421	28.8	99.9	.980
3	2.841	.1	100.0	.860

Table 5. Canonical discriminant function. Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 3	.001	116.746	36	.001
2 through 3	.001	59.924	22	.001
3	.260	9.420	10	.493

Table 6. Functions at group centroids

Modules	Function		
	1	2	3
1	-110.235	-30.238	1.644
2	44.192	11.538	1.659
3	18.432	-27.385	-1.302
4	-37.027	55.699	-1.258

The first canonical function explains the variation of results by 71.1%, the second – by 28.8%, which indicates a high informativeness of the first and second canonical functions ($r = 0.98$) (see Table 4). Table 5 shows the material of the analysis of canonical functions. The first line contains the value $\lambda_1 = 0.001$ and statistical significance $p = 0.001$ for the whole set of canonical functions, the second line contains

data after excluding the second function ($\lambda_2 = 0.001$, $p = 0.001$). The first and second functions have a high discriminant ability and value in the interpretation of the general population.

The graphic material given in Fig. 1 shows a clear boundary between the level of knowledge of the four modules of the course. In the positive pole of the first function, there are average values of the level of knowledge (centroids) of the second and third modules, in the negative – average values of the level of knowledge (centroids) of the first and fourth modules (Table 6).

According to the analysis of the first function, the students have better knowledge of the modules “Means and Methods of Physical Education”, “Theory and Methods of Motor Abilities Development”; according to the analysis of the second function, the module “Theory and Methods of Teaching Motor Actions” has the highest value.

Discussion

The paper assumed that the use of multidimensional statistics would provide an opportunity to obtain new information about the curriculum structure in the process of training a physical education teacher.

It was found that factor and discriminant analysis provides objective information on the quality of training a physical education teacher. The results of factor analysis do not confirm the objectivity of empirical identification of four groups of academic subjects. The factor structure of the curriculum indicates the need to change the content of education, aimed at improving the training of highly qualified teachers.

Fig. 1. Canonical discriminant functions. Graphic representation of the results of classification of knowledge assessment by four modules: 1 – “Physical Education in Education System”, 2 – “Means and Methods of Physical Education”, 3 – “Theory and Methods of Motor Abilities Development”, 4 – “Theory and Methods of Teaching Motor Actions”

The training of physical education teachers should include the following blocks of subjects: professional theoretical and practical training, natural sciences, theory and methods of physical education of schoolchildren, special training in the chosen sport.

The obtained results supplement the data of Kravchuk (2006, 2008) on the trends in curricula changes, the basis of which is the balance of time allotted for general, pedagogical, and special training.

The results of factor analysis confirm the opinion of Backman and Barker (2020) that the training of physical education teachers should include the development of: 1) knowledge of technique and tactics of physical exercises; 2) knowledge of programming the process of teaching physical exercises; 3) knowledge of quality assessment of the educational process. The level of competence of physical education teachers should be quantitative.

The results of discriminant analysis confirm the thematic integrity of the subject "General Principles of Theory and Methods of Physical Education" and supplement the data of Roters (2007), Serhiienko (2009, 2010) on planning the study of special subjects; those of Khudolii and Ivashchenko (2008, 2012), Ivashchenko and Khudolii (2010) on teaching the subject "Theory and Methods of Physical Education" in the process of training a physical education teacher; Khudolii and Zabora (2002) on the state and ways to improve the teaching of special subjects in the system of basic education at physical education schools of pedagogical educational institutions.

Conclusions

Factor and discriminant analysis provided objective information on the quality of physical education teacher training. The results of factor analysis do not confirm the objectivity of empirical identification of four groups of academic subjects of the curriculum. The factor structure of the curriculum indicates the need to change the content of education, aimed at improving the training of highly qualified teachers. The training of a physical education teacher should include the following blocks of subjects: professional theoretical and practical training, natural sciences, theory and methods of physical education of schoolchildren, special training in the chosen sport.

The results of discriminant analysis show that physical education teacher training is aimed at developing knowledge, abilities and skills in the sections: 1) Means and Methods of Physical Education; 2) Theory and Methods of Motor Abilities Development; 3) Theory and Methods of Teaching Motor Actions.

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Conflict of interest

The authors declare no conflict of interest.

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ДИДАКТИКА: МЕТОДОЛОГІЧНІ ПІДХОДИ ДО ВИЗНАЧЕННЯ ЗМІСТУ ПІДГОТОВКИ ВЧИТЕЛЯ ФІЗИЧНОЇ КУЛЬТУРИ

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

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Мета дослідження – розробити методологічні підходи до визначення змісту підготовки вчителя фізичної культури.

Матеріал і методи. У дослідженні взяли участь 62 студенти факультету фізичного виховання, які навчалися за навчальним планом 2001-2005 рр. Для вирішення поставлених завдань були використані як філософські, так і загальнонаукові методи дослідження, серед яких: діалектичний метод (принцип історизму, принцип системності, принцип діалектичного протиріччя, принцип єдності якості і кількості, принцип діалектичного заперечення, принцип розвитку, принцип причинності); системний підхід; факторний і дискримінантний аналіз.

Результати. Результати аналізу успішності свідчать про середній рівень володіння навчальним ма-

теріалом. За величиною коефіцієнта варіації оцінки з «Історія сучасного світу», «Культурологія», «Гімнастика», «ТМФВ, 3 курс» мають значні коливання (>33%). Успішність студентів з дисциплін «ЛФК», «Основи екології», «Дипломна робота» має середній рівень коливання. За більшістю показників студенти оцінюються як однорідна група. Аналіз спільностей (h2) показав, що найбільш інформативними показниками якості підготовленості студентів є оцінка з дисциплін: «Педагогічна практика в школі (середні класи)» (0.817); «Біомеханіка» (0.772); «Кваліфікаційний іспит» (0.764); «Педагогічна практика в школі (старші класи)» (0.763).

Висновки. Факторний і дискримінантний аналіз дозволив отримати об'єктивну інформацію про якість підготовки вчителя фізичної культури.

Результати факторного аналізу не підтверджують об'єктивність емпіричного виділення чотирьох груп навчальних предметів навчального плану. Факторна структура навчального плану вказує на необхідність зміни змісту навчання, спрямованого на поліпшення підготовки учителя високої кваліфікації. Підготовка вчителя фізичної культури повинна включати блоки дисциплін: фахової теоретичної і практичної підготовки, природничо-наукової підготовки, теорії і методики фізичного виховання школярів, спеціальної підготовки в обраному

виді спорту. Результати дискримінантного аналізу вказують на те, що підготовка вчителя фізичної культури спрямована на формування знань, умінь і навичок за розділами: 1) «Засоби і методи фізичного виховання»; 2) «Теорія і методика розвитку рухових здібностей»; 3) «Теорія і методика навчання рухових дій».

Keywords: вчитель фізичної культури, зміст підготовки, факторний аналіз, дискримінантний аналіз.

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