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 Xiaqian, 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 Marijck C., and Westerheijden Don F. (2018).

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

| No. | Subjects                                      | X    | S     | V     | As       | Ex     |
|-----|----------------------------------------------|------|-------|-------|----------|--------|
| 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   | Cultureology                                 | 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 | h²     |
|-----|-----------------------------------------------|---------|--------|
| 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  | 0.539  |
| 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). The factor characterizes practical and theoretical competence of graduates. The factor is called the Theory and Methods of Physical Education and Sports Subjects.

The second factor explains the variation of total dispersion by 24.294%. 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 (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).

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 |
The 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 first and fourth modules, in the negative – average values of the level of knowledge (centroids) of the second and third 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.
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), Sherhienko (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.
ДИДАКТИКА: МЕТОДОЛОГІЧНІ ПІДХОДИ ДО ВИЗНАЧЕННЯ ЗМІСТУ ПІДГОТОВКИ ВЧИТЕЛЯ ФІЗИЧНОЇ КУЛЬТУРИ

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статистичний аналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 6 с., 6 табл., 1 рис., 21 джерело.

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 едності якості і кількості, принцип діалектичного замикання, принцип розвитку, принцип причинності); системний підхід; факторний і дискримінантний аналіз.

Результати. Результати аналізу успішності свідчать про середній рівень володіння навчальним матеріалом. За величиною коефіцієнта вариативності 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 спільності (h2) показав, що найбільш інформативними показниками якості підготовленості студентів є оцінка з дисциплін: «Педагогічна практика в школі (середні класи)» (0.817); «Робота з фізичним вихованням» (0.772); «Методика виховання у спортивному і юнацькому спорту» (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.
Результаты факторного анализа не подтверждают объективность эмпирического выделения четырех групп учебных предметов учебного плана. Факторная структура учебного плана ведет к необходимости изменения содержания подготовки учителя высокой квалификации. Педагогика ведущей физической культуры должна включать блоки дисциплин: физической подготовки и практических навыков, природно-научной подготовки, теории и методики физического воспитания школьников, специальной подготовки в обозранных виде спорта. Результаты дискриминационного анализа ведут к тому, что подготовка ведущего физической культуры направлена на формирование знаний, умений и навыков по разделам: 1) «Средства и методы физического воспитания»; 2) «Теория и методика развития рукохватных способностей»; 3) «Теория и методика обучения ручных движений».

**Keywords:** ведущий физической культуры, содержание подготовки, факторный анализ, дискриминационный анализ.

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