

Original Article

Development skills implementation of analysis of variance at sport-pedagogical and biomedical researches

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Published online: November 30, 2019

(Accepted for publication: November 15, 2019)

DOI:10.7752/jpes.2019.s6311

Abstract

Development skills implementation of analysis of variance at sport-pedagogical, medical and biological researches. Modern scientists are actively working to improve the training process of sportsmen. Theoretical substantiation and correct interpretation of the results provide an opportunity to be in advance in the effectiveness of the proposals. A wide class of significance tests is based on the analysis of variance. *The purpose of the article* is developing the methodology for the formation practical skills of using analysis of variance to analyze the results of sports, pedagogical and biomedical researches for students in the field of physical education and sports. *Results.* A method of forming students' practical skills for the implementation of variance analysis of sports-pedagogical and biomedical data is proposed. The implementation of the method involves focusing students' attention on the implementation of analysis of variance using computer programs. Automation of the calculation process allows students of the Faculty of Physical Education and Sport to do statistically mathematical data processing at a high level.

Key words: formation, statistics, research, analysis, factor, dispersion.

Introduction

The development of modern sports is connected with of improving the training process and scientists are making considerable efforts to find promising techniques and technologies that can achieve the potential of sportsmen (Kostiukevych V., Imas Ye., Borysova O., Dutchak M., Shynkaruk O., et al., 2018).

Sports are often accompanied by the maximum mobilization of the functional reserves of the sportsmen's body . Therefore, at present, the development of scientists aimed at optimizing training loads is increasingly actual in the practice of sports training (Kostiukevych V., Shchepotina N., Shynkaruk O., et al., 2019). However, the quality of research directly depends on the adequacy of the applied methods of statistical analysis, since the erroneous use of statistics negates the meaning of the research activity. (Denisova, 2012).

Actually, the publication the results of research work involves competent statistical processing of empirical data (Byshevets, 2017, Fundamentals of research work for higher education graduates in the field of Physical Culture and Sports, 2019). Only under such conditions, it is possible to use the results of theoretical reasoning in the practice of sports. Therefore, a highly qualified specialist in physical culture and sports should be fluent in the tools of statistical research (Byshevets, 2018, Byshevets N., Denysova L., Shynkaruk O. et al., 2019). A review of the scientific, methodological and specialized literature, which reflects the problems of preparing students for the field of physical education and sports, has shown that at present, scientists widely use the mathematical and statistical apparatus to substantiate their findings (Stroganov, 2013; Michael 2010). However, the incorrect use of statistical methods and criteria can lead to a distortion of the results of experimental activity and false conclusions. However, in experimental medicine and in the field of physical culture and sport there are scientific works, the declared results of which raise doubts (Lang, 2016)

As in the case of evidence-based medicine (Leonov, 2012), the use of mathematical estimates of the probability of the effect or its absence under the influence obtained in scientific studies on samples of athletes leads the decision to apply a particular training method. Therefore, future specialists need to have statistical knowledge and form practical skills of statistical processing of experimental data.

An analysis of variance is a well-known method for assessing the statistical significance of differences between sample populations, developed in the 1920s by the English mathematician Fisher; it is the base of a wide class of significance criteria. (Glantz, 1998). It was found out that scientists described the use of analysis of variance in psychological and pedagogical research in detail (Kolesnikov, 2010; Slepko, 2015; Lebedeva, 2017), considered the practical side of using analysis of variance to improve the system of sports selection (Drozdovskaya, 2015).

However, analysis of literary sources has shown that at present specialists have not presented the

methodology for the formation of practical skills in the use of variance analysis by students for the analysis of sports, educational and biomedical data.

Research purpose – to develop a methodology for the formation of practical skills of using analysis of variance for students in the field of physical education and sports for analyzing the results of sports, pedagogical and biomedical research

Material and methods.

Used methods include the analysis and analysis of scientific and methodical literature, Internet data and mathematical statistics methods, including computer data processing.

Results.

In the course of the study, we have identified the pedagogical conditions for the formation of practical skills in the use of analysis of variance for sports, pedagogical and biomedical data in students of the higher establishments. Among such conditions should include the following:

- expansion of the theoretical base on methods of analysis of variance, conditions of its use, features of the ANOVA procedure;
- use of professionally-oriented tasks;
- availability of a clear algorithm for the stages of analysis using IT.

The method of forming students' practical skills for the implementation of analysis of variance is presented in the picture. (fig. 1).

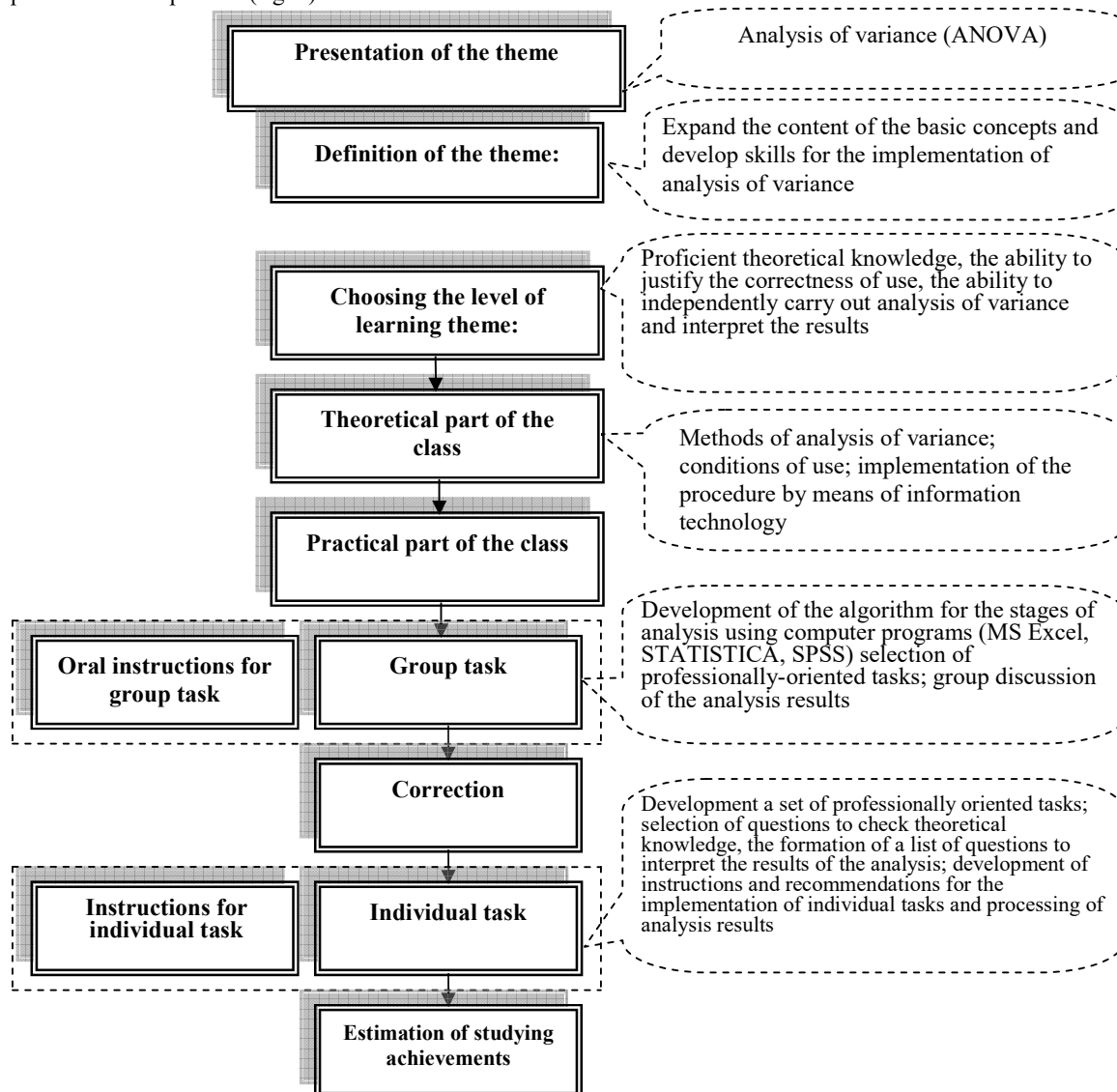


Fig. 1. Methods of forming students' practical skills for the implementation of variance analysis of sports-pedagogical and biomedical data

We consider the implementation of the methodology for developing students' practical skills in the implementation of variance analysis of sports-pedagogical and biomedical data. It should be noted that the peculiarity of the proposed method is due to the content of the professional training of future specialists in physical culture and sports. First, they are:

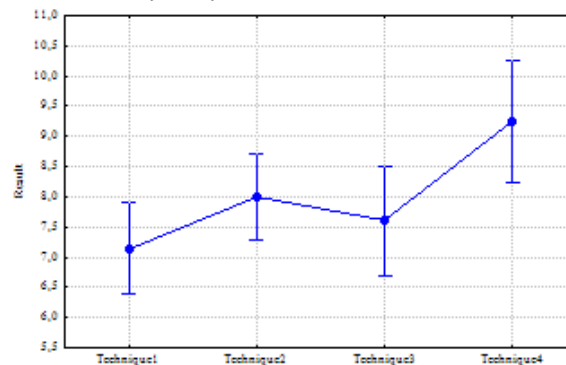
- minimization of theoretical statements;
- focus on the formation of practical skills in students;
- automation of the counting procedure ANOVA.

At the stage of covering the theoretical part, students are informed that the purpose of analysis of variance is to test hypotheses about the connection between certain characteristics and the studied factors that do not have a quantitative understanding, as well as to establish the degree of influence of factors - circumstances affecting the result, and their interaction. The basis of the analysis of variance, which is considered as a parametric criterion for comparing the means between several sample sets, is the study of the components of the variance. We emphasize that analysis of variance, depending on the number of factors, is equal to one-way analysis of variance ANOVA, two-way ANOVA, or multivariate analysis of variance. We emphasize the need to fulfill the conditions: the normal distribution of the characteristic from which the sample was obtained; equality of dispersions of the test characteristic (Gusev, 2000) At the stage of the formation of practical skills, we offer to solve the problem. For example, 24 sportsmen of the same level of physical fitness trained in four different methods. At the end of the study, they performed a test exercise. Input data are presented in Picture 2 (a). The task is to assess the impact of the training methodology on the results of the test exercise.

Using the criterion of homogeneity of variance for Leven's Test, we test the hypothesis that all distributions of the dependent variable for the compared samples have the same variances. As it can be seen from Picture 2 (c), $p > 0.05$, therefore the variance of the compared groups are homogeneous, that is, there are no qualitative differences between them. Therefore, the use of one-way analysis of variance ANOVA is reasonable.

Technique				
1	2	3	4	
6	7	6	10	
8	7	8	9	
7	9	7	10	
8	8	9	8	
8	7	8		
7	8			
6	9			
	9			

a) Input data



b) Graph of average test results

	MS Effect	MS Error	F	p
Result	0,024620	0,220336	0,111740	0,952226

Effect	Degr. of Freedom	Result SS	Result MS	Result F	Result p
Intercept	1	1425,831	1425,831	1516,265	0,000000
Technique	3	11,818	3,939	4,189	0,018732
Error	20	18,807	0,940		
Total	23	30,625			

c) Estimation homogeneity of variance for Leven's Test

d) Calculation of Fisher test

Cell No.	Technique	{1}	{2}	{3}	{4}
1	Technique1	7,1429	8,0000	7,6000	9,2500
2	Technique2	0,618821	0,618821	1,000000	0,288813
3	Technique3	1,000000	1,000000		0,117832
4	Technique4	0,014611	0,288813	0,117832	

Cell No.	Technique	{1}	{2}	{3}	{4}
1	Technique1	7,1429	8,0000	7,6000	9,2500
2	Technique2	0,425364	0,425364	0,884087	0,250999
3	Technique3	0,884087	0,912380		0,126519
4	Technique4	0,021956	0,250999	0,126519	

e) Comparing averages for Bonferroni test

f) Comparing averages for Scheffe test

Pic. 2. Implementation of one-factor analysis of variance in the program STATISTICA 7.0

After performing the standard procedure of calculating the Fisher criterion using MS Excel, STATISTICA or SPSS (d), we establish the presence of statistically significant differences between the results of the test exercise in the compared groups of athletes according to the Fisher criterion ($p < 0.05$). Hence, the training method has a significant impact on the results of the test exercise performed by sportsmen. Graph (b) shows that Method 4 turned out to be the most effective, and Method 1 turned out to be the least effective. In addition, the use of the procedure for pairwise comparisons of averages both by the Bonferroni test (e) and by the Scheffe test (f) proves that a statistically significant ($p < 0.05$) the difference between the results of the test exercises performed by sportsmen engaged in methods 1 and 4. That is, method 4 is more effective than method 1. It is clear that the use of computer programs allows you to automate the process of calculations and greatly simplifies the data analysis procedure. This allows students in the field of physical culture and sports, who usually do not have a solid mathematical background, to perform statistically mathematical data processing.

Discussion.

The study showed that analysis of variance is quite common in psychological and pedagogical research.

Scientists A.N. Gusev (2010), Yu.N. Slepko, T.V. Ledovskaya, A.E. Tsymbaliuk (2015) dealt with the peculiarities the use analysis of variance in experimental studies. Indeed, analysis of variance helps to solve a number of press issues related to estimating differences between sample averages of variable number of groups, investigate or differences between groups are determined by controlled factors and determine the value of the influence of each factor and their interaction (Lupan 2010), These reasons make it quite important for analysis of sports and educational data.

In order to form professional competencies of future ecologists S.I. Toropov (2017) studied the possibilities using the potential of methods and means of mathematical statistics. In the process of selecting the most significant themes of the content of teaching mathematical statistics in classrooms among other topics, the author paid attention on the importance of learning the basics of analysis of variance. For the training of future statisticians, I.V. Lupan (2010) proposed practical tasks for the analysis of variance and presented examples of their solution by means of the most common computer statistical packages.

In addition, it has long been tested and has a well-known systematic algorithm for computing. A number of computer programs automate the implementation of the ANOVA procedure, which gives significant prospects for the use analysis of variance for a wide range of researchers. However, despite this, students of physical education and medical higher educational institutions do not have a clear idea about the purpose of analysis of variance and interpretation of the results of computational procedures.

Obviously, at present, due to the increasing requirements for the quality of scientific work in the field of physical education and sport, it is expedient to develop practical skills for applying dispersion analysis in students of establishments of higher education for analyzing the results of sports-pedagogical and biomedical research.

Conclusions and perspectives of further research.

The theory and practice of sports training requires more accurate and reasonable research results.

The scientific level of experimental work depends on the level of proficiency of the scientific and pedagogical community researches by the methods of statistical processing of experimental data.

Incorrect use of the statistical apparatus distorts the results of experimental activity and leads to erroneous conclusions.

One of the tasks of the system of training students in the field of physical education and sports is the formation of skills for processing research results, their having with the necessary theoretical knowledge, practical skills and skills to use modern information technologies to solve professionally oriented tasks.

Analysis of variance involves the establishment of a relationship between the qualitative (nominal) characteristics and the quantitative (continuous) variable.

A method of forming students' practical skills for the implementation of variance analysis of sports-pedagogical and biomedical data is proposed. Its characteristic feature is to focus the attention of future specialists in physical culture and sports on the practical part of the implementation of analysis of variance by means of IT.

Prospects for further research are to illustrate the methods of forming statistical knowledge and practical skills of students in the field of physical education and sports on statistical analysis of data in sports, educational and medical-biological research.

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