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SYSTEMATIC APPROACH AND STUDENT COMPETENCIES FORMATION WHEN STUDYING STATISTICS

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Abstract

In the present paper, a process of forming of student's professional competences during the «General theory of statistic» learning is considered in the form of a management system with a formal description of its elements and connections. Today when a sphere of higher education is subjected to particular transformations. Educational standards are changed, competent approach and interactive learning forms which demand the unification of learning activity and estimation procedures are implemented the system approach actuality for an educational process organization of higher educational establishment is confirmed with modern reality. Through the implementation such methods of scientific research as analysis and synthesis as well as modelling and analogies there was confirmed a principled possibility for a forming of student's professional competences during the «General theory of statistic» learning in frames of the system approach, its workability was also confirmed. The article deals with the experience of forming students' competencies in connection with changes in educational standards.

Keywords: Discipline, professional competence

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1. Introduction

The system approach is a branch of a scientific cognition methodology where the object is considered as a system, i.e., a complex of communications relation. Such an approach is used in all processes where it is possible to mark out an object and a subject of the management as well as direct and reverse communications between them. In that case, the process of competence mastering by a student during the learning of any discipline in the higher educational establishment (including the General theory of statistic) can be observed from the position of the system approach (Figure 1) (Dobrynyna & Trusova, 2017; Efremova, 2015).

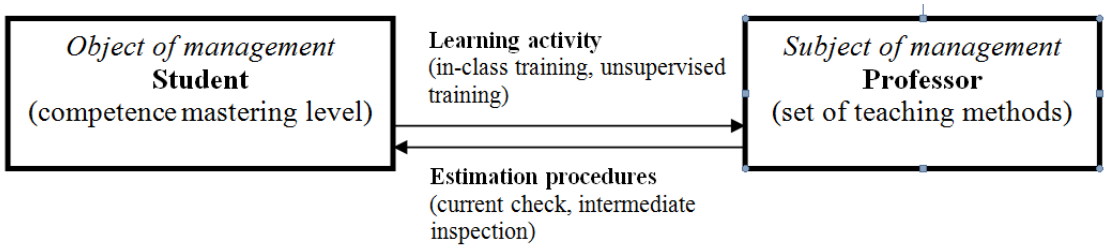

Figure 1. A system organization of competence mastering process by a student during the discipline learning

Marked system elements: manageable subsystem (student – the object of management), managing subsystem (professor – the subject of management) as well as direct (learning activity) and reverse (estimation procedures) connections between them form the whole system of process organization for competence mastering by a student during the General theory of statistic learning which is in this paper in detail considered.

2. Problem Statement

The upcoming transformation of educational activities is carried out in accordance with the requirements of new educational standards. Therefore, it is necessary to take preventive measures to increase the universality and adaptability of educational and assessment procedures in academic disciplines, in particular, the general theory of statistics. Such measures allow, among other things, bringing the discipline to a new interactive level, facilitate the implementation of distance learning technologies. As a result, the quality of training bachelors will increase, and the depth of their professional competence will develop. This result can be achieved by presenting the organization of the process of mastering the student competencies when studying the general theory of statistics from the standpoint of a systems approach (Shilova, 2017).

3. Research Questions

System views of the student competences process formation in the study of the General theory of statistics need to identify and to describe in detail the direct and inverse relations between the elements of

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such a management system. That is, the issue is considering the organization of the classroom and independent work, contra current and interim assessment of students during the discipline learning.

4. Purpose of the Study

The article aimed to the identification and describing the direct and feedback elements of the students' professional competence system formation, to scientifically substantiating the principal possibility of professional competences formation by students while studying the discipline "General theory of statistics" with the system approach.

5. Research Methods

Representation of the professional competencies formation process by a student in the study of the General theory of statistics as a management system is possible using universal scientific methods of modelling and analogies, analysis and synthesis.

6. Findings

6.1. The system organization of in-class and unsupervised training of a student during the «General theory of statistic» learning

A teaching of the «General theory of statistic» discipline (hereinafter a discipline) in FGBOU VO «PGU» is regulated by the set of teaching methods which was developed by the higher educational establishment and placed in the electronic-information educational media according to FGOS VO in the field of training 38.03.01 «Economics». This set represents a system of normative documents regulating learning activity and estimated procedures about a discipline (Figure 2).

The discipline provides a Bachelor of Economics with general skills, analytical and also research training. This discipline is a basic part of mandatory curriculum disciplines, and it is necessary for a forming of general professional (GPC-2) and professional (PC-6) competencies defined by FGOS VO (Figure 3).

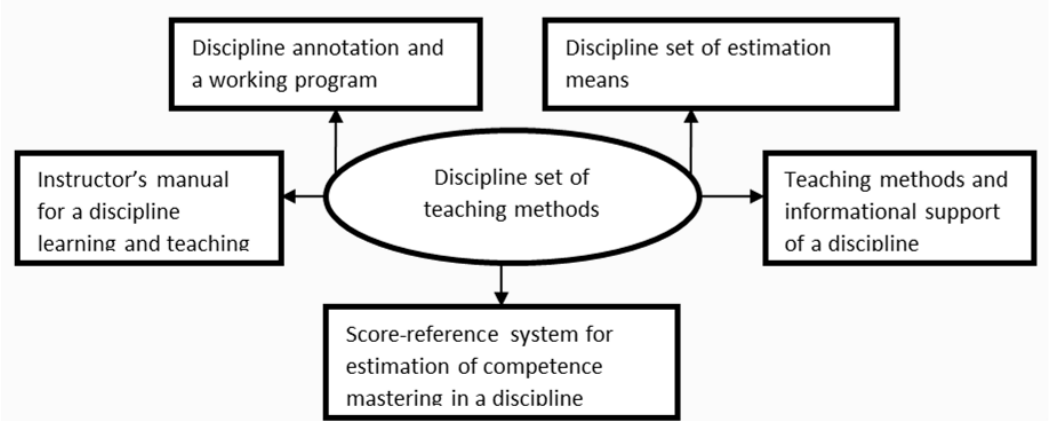

Figure 2. A Discipline set structure of teaching methods

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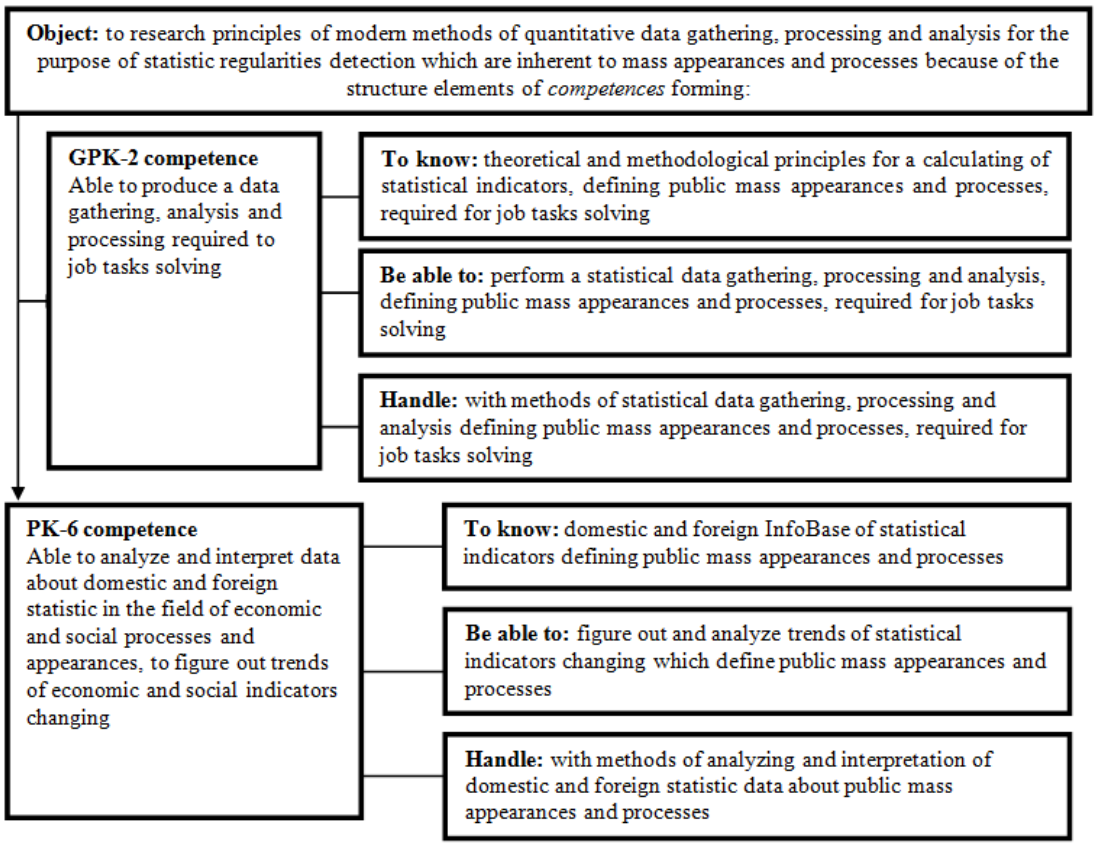

Figure 3. Discipline object in frames of the competence approach

The labour intensity of the discipline learning activity is 5 credits or 180 hours, including in-class training – 54 hours and unsupervised training – 126 hours (Table 1; Figure 4).

A student's in-class training is supposed to consist of lectures and lab researches. Discipline lectures act as methodological function giving a school for lab researches. Lab researches consolidate student's knowledge received during lectures. A student's unsupervised training is supposed to consist of a term paper execution, a preparation for in-class training and exam.

Table 1. The labour intensity of the discipline learning

In-class training 54 hours including:		Unsupervised training 126 hours including:				
		Term paper execution		Preparation for an in-class training		Preparation for an exam
Lecture	Lab research	Project preparation	Preparation for an interview	Calculation and graphic work execution	Preparation for an interview	Preparation for a thematic test
36 hours	18 hours	48 hours		42 hours		36 hours

A term *paper execution* is supposed to consist of the project preparation and the performance of an interview by its main sections.

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Every student does his project individually. The project assumes the performance of calculation and analytical procedures and then making up an explanation note based on its results. During the interview, a professor asks a qualifying question about calculations, conclusions and recommendations given by a student in his explanation note for a project. Questions submitted to the discussion correspond to estimation positions of the term paper.

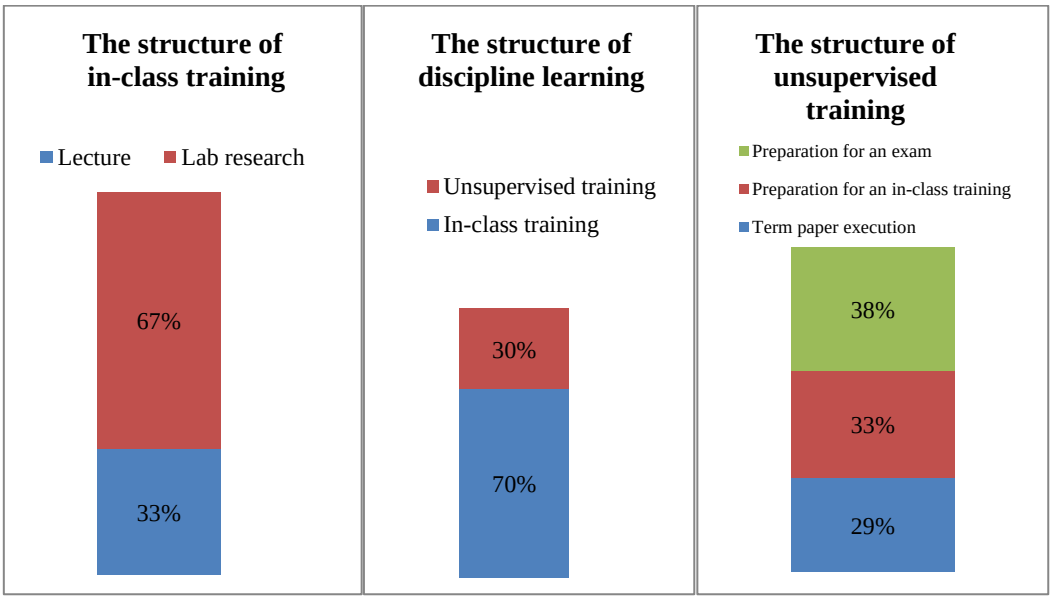

Figure 4. Composition (hours) and structure (%) of the discipline learning activity

A student's preparation for an *in-class training* is supposed to consist of calculation and graphic works and preparation for an interview based on its results.

Calculation and graphic works are performed according to target themes of discipline and assume execution of calculation procedures, tables making and graphs forming. Results of calculation and graphic works are formed by a student in the form of electronic reports. Every work should be defended by a student in the form of the interview where a professor asks qualifying questions about calculations, conclusions and recommendations given by a student in frames of theoretical and conceptual set about the work issue.

During the lab research on every single theme of the discipline, a student makes thematic tests using the computer system «Ellekta», which was developed by FGBOU VO «PGU» and placed in university electronic-information educational media (Koshevoi, 2005; Koshevoi et al., 2019). A goal of the thematic testing is to train a student for a final test in a control point as well as for an exam.

A student's training for an exam is supposed to consist of training for a final test. A student should work out lecture materials. The study recommended methodological and periodical literature; make an Internet-resources search.

A student submits the results of his unsupervised training on in-class training, where a professor estimates it during the current check and intermediate inspection according to a score-reference system adopted in FGBOU VO «PGU».

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6.2. A system organization of the current check and intermediate inspection of a student during the «General theory of statistic» learning

A level of the competence mastering process by a student during the discipline learning is controlled by a professor in frames of estimation procedures of current check and intermediate inspection using estimation means system (Galkin et al., 2018).

Current check is performed in the form of control points setting through estimation of calculation and graphic works, a defence of work results by an interview, thematic tests making and also based on student's in-class training attendance.

Using 100-score estimation scale, a student got up to 1 score for every single complete calculation and graphic work and passed interview (Table 2).

Using 100-score estimation scale a student's in-class training attendance is estimated as 0,5 score. A student's absence because of reasonable excuse is considered as a conditional presence

Using 100-score estimation scale, a student gets one score for every correct made thematic test task. The quantity of such tasks which are given to a student in a control point (T) is calculated as follows:

$$T = MAX – (1 \times ГР + 1 \times C + 0,5 \times K),$$

where:

- MAX – maximum score quantity able to be received by a student in a control point;
- ГР – a quantity of made an estimated calculation and graphic works before the control point;
- C – a quantity of passed interviews based on calculation and graphic works results before the control point;
- K – a quantity of in-class pieces of training before the control point. **The intermediate inspection** is realized in the form of an exam and a term paper.

The exam in the form of the final test using a computer system «Ellekta» takes place in a computer class. A student is supposed to make 40 test tasks which are randomly taken out from a fund of thematic test fund. Using 100-score estimation scale, a student gets one score for every correct made thematic test task. The final test is supposed to be passed when a student gets not less than 24 scores.

Table 2. Estimation criteria for calculation and graphic work

Score	Calculation and graphic work	Interview
from 0,75 to 1,00	The work corresponds to a learning object. Its content corresponds to a given task, a work's report formed according to the University STO PGU 3.12-2018 standard (after this a standard) requirements, the report has a sufficient size, logically and informatively completed, has the necessary quantity of reference lists. There is no doubt in its actuality, statistic indicators are calculated, tables are filled, graphs are drawn, analysis is shown, conclusions are formed, there are no methodological mistakes or conceptual inaccuracies during the demonstration of completed calculations.	A student answered all questions during the interview in detail, at the same time he demonstrated competent and scientific material description, deep understanding of the issue, his answers were corroborated with practical examples, during the answer a student demonstrated sufficient knowledge of lecture and additional material about the discussed object.

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from 0,50 to 0,75	The same, except little methodological mistakes and conceptual inaccuracies which were found during the demonstration of completed calculations.	The same, but a student did not corroborate answers with practical examples and also did not demonstrate knowledge of additional material about the discussed object.
from 0,25 to 0,50	The same, but there is some doubt about reference lists actuality, and also bad methodological mistakes and conceptual inaccuracies were found during the demonstration of completed calculations.	The same, but a student answered not all questions, during the answering demonstrated surface knowledge of lecture material about the discussed object.
from 0,00 to 0,25	The same, but the work content does not correspond to a given task, a work's report did not form according to standard requirements, the report size is not sufficient, logically and informatively not completed, there is some doubt about reference lists actuality and also bad methodological mistakes and conceptual inaccuracies was found during the demonstration of completed calculations.	The same, but a student did not answer most of the questions, during the answering demonstrated surface knowledge of lecture material about the discussed object.

A discipline term paper is supposed to consist of project preparation and interview based on its main sections (Table 3).

At an average by estimation positions of a term paper, a student should get 24 scores.

Therefore, during the intermediate inspection, the student's rating, which was formed according to the score-reference system, is summed up. Then using an estimation scale, adopted in FGBOU VO «PGU», a student is received a total score and also exam and term paper score (Table 4) (Lavrentiev & Lavrentieva, 2018).

For the discipline mastering the higher educational establishment has modern material and technical basis which provides practical, analytical and research work of a student assuming one personal computer with Internet per 2–3 students. A presence of multimedia equipment (projector, multimedia lecture hall) and licensed software (PC MSExcel, MSOffice, PowerPoint, Ellekta) (Lyubimtseva, 2017) is compulsory.

Table 3. Estimation criteria for a term paper

	Estimated position of a term paper			
	Project		Interview	
Score	Quality of preparation and forming of main sections of the project's explanation note	Degree of an author's contribution into conclusions and recommendations based on project results forming	Degree of studying goals received by a student and realization of studying objects	Level of professional competence mastering demonstrated during the interview
from 30 to 40	Statistical indicators are calculated, graphic material is formed, analysis is demonstrated, conclusions are formed, explanation note is made according to standard requirements textually and electronically.	Conclusions are competent and reasonable, the quantity of reference lists is sufficient, and there is no doubt in its actuality, singularity level after a plagiarism checking is more than 80 %.	During the questions answering a student demonstrated good knowledge about the conceptual discipline set, all statistical indicators are methodologically correct calculated.	During the questions answering a student demonstrated very good ability to gather, to analyze and process statistical data, to interpret the main, and to predict social and economic indicators changing.

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from 20 to 30	The same, but the analysis is not shown.	The same, but a singularity level after a plagiarism checking is 75–80 %.	The same, but only more than 75 % of statistical indicators are methodologically correct calculated.	The same, but during the questions answering a student demonstrated sufficient ability to gather, to analyze and process statistical data, to interpret the main, and to predict social and economic indicators changing.
From 10 to 20	The same, but the analysis is not shown, the explanatory note is made with some standard requirements breaches.	The same, but conclusions are not competent enough; there is a doubt in reference list actuality, a singularity level after a plagiarism checking is 70–75 %.	The same, but a student did not demonstrate a good knowledge about the conceptual discipline set, more than 50 % of statistical indicators are methodologically correct calculated.	The same, but during the questions answering a student demonstrated bad ability to gather, to analyze and process statistical data, to interpret the main, and to predict social and economic indicators changing.
From 0 to 10	The same, but the analysis is not shown, conclusions are not formulated, the explanatory note is made with gross standard requirements breaches.	The same but there are no conclusions or they are not competent enough, there is a doubt in reference list actuality, a singularity level after a plagiarism checking is less than 70 %.	The same, but a student did not demonstrate a good knowledge about the conceptual discipline set, less than 50 % of statistical indicators are methodologically correct calculated.	The same, but during the questions answering a student did not demonstrate an ability to gather, to analyze and process statistical data, to interpret the main and to predict social and economic indicators changing.

Table 4. Estimation criteria of the discipline competence mastering

Current inspection				Intermediate inspection		Score	
Calculation and graphic work	Interview	Class attendance	Thematic test (control points)	Final test (exam)	Project, interview (term paper)	100 score	4 score
Up to 1 score for every calculation and graphic work (14 works) min 5 scores/ max 14 scores	Up to 1 score for every interview and graphic work (14 interviews) min 5 scores/ max 14 scores	0,5 score for every class attendance (28 classes) min 5 scores/ max 14 scores	1 score for a correct test task (18 tasks) min 9 scores/ max 18 scores	1 score for a correct test task (40 tasks)	Averaging of term paper estimation positions (4 positions)	88–100 74–87 60–73 0–59	5 4 3 2
min 36 scores/ max 60 scores				min 24 scores/ max 40 scores		min 60 scores/ max 100 scores	

7. Conclusion

In this paper, the ability of process organization of student's competence mastering during the general theory of statistic learning was scientifically proved from the system approach position. Elements and connections composed such a system was described in detail. In a further, it will help to FGBOU VO «PGU» to automate a learning activity and estimation procedures during the discipline learning, to bring it on a new interactive level, to increase the communication speed between a student and a professor, to improve a quality of a bachelor training through the increase of the competence mastering level

(Chukhacheva, 2019). Besides, this system description of the competence mastering process is characterized by an absolute generality. Therefore, the described in the paper general learning and estimation processes could be implemented in the educational system of any discipline in a higher educational establishment. It is also important to note that the process of competence mastering by a student during the «General theory of statistic» learning is positioned like a managing system, so later during the transition to a new educational standard it would make the structure reformatting of the discipline easier.

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