

# The elective as a prospect of the students' research work intentional development

## La asignatura facultativa como perspectiva del desarrollo intencional del trabajo de investigación de los estudiantes

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#### ABSTRACT:

In order to improve the scientific content in the course work and the course project presentation writing, the author has examined the experience of "The Research and Evaluation Fundamentals" elective course introduction into the educational process. Using the dispersion analysis methods, a detailed study of the course work and project presentation results was carried out before and after the elective inclusion into the current schedule. A practical experiment has been conducted at Industrial University of Tyumen at the Chair of Business Informatics and Mathematics with the participation of EBb - 15 - 1 and EBb -15 - 2 group students.

**Keywords:** Course work, course project, elective, scientific activity.

#### RESUMEN:

Con el fin de mejorar el contenido científico en el trabajo del curso y la redacción de la presentación del proyecto del curso, el autor ha examinado la experiencia de la introducción electiva del curso "Fundamentos de la investigación y la evaluación" en el proceso educativo. Utilizando los métodos de análisis de dispersión, un estudio detallado de el trabajo del curso y los resultados de presentación del proyecto se llevaron a cabo antes y después de la inclusión electiva en el cronograma actual. Se realizó un experimento práctico en la Universidad Industrial de Tyumen en la Cátedra de Informática Empresarial y Matemáticas con la participación de EBb - 15 - 1 y EBb -15 - 2 estudiantes del grupo. Palabras clave: trabajo de curso, proyecto de curso, asignatura facultativa, actividad científica.

## 1. Introduction

One of the most important types of the student scientific activity and independent work is the course work or the course project writing and presentation [8].

The course work can be considered as a summary results of the research conducted by the student himself or as a generalization of the practical experience with the conclusions and

concrete proposals for its improvement [10]. In most cases, the student research work contains the scientific work elements such as the problematic or debating points identifying, the formulation and argumentation of one's own attitude to the problem, with a reasoned argument of one's own proposals and conclusions [1].

The consolidation of the theoretical knowledge obtained, the literature references independent analysis skill-building, the research work with a factual material skill-building are the main goals of the course work writing and presentation [6].

During the conscious choice of the topic and the responsible course work writing the following tasks are solved:

- the knowledge on separate sections of the course and on the discipline in general is deepened;
- the student research work skills are developed;
- there is the possibility of a defensible integration of the theoretical knowledge and the practical skills;
- the thought independence is developed, the student is taught how to express his thoughts logically correct and in a convincing manner when analyzing the complex theoretical issues;
- The independent work skills development on the collecting, studying, analyzing and summarizing the theoretical material necessary for the topic disclosure;
- There is an opportunity to discuss the investigated problems on the topic of the work at the research-to-practice conference;
- The formation of the psychological and methodological readiness for the independent work is carried out.

Along with the course work writing, one of the student research activity types is the course project writing and presentation.

The course project, in contrast to the course work, necessarily contains a technical project on the investigated topic. In this case, the course project may include an economic part containing the effectiveness analysis of the performed calculation application or related to the organization of the proposed product implementation. An explanatory note that presents the basic theory and calculations is the main difference between the course project and the course work.

A competently executed and presented course project can be used as the first stage of the graduation thesis development in future [9].

## 2. Methods of research

During the first year of the pursuing a bachelor's degree in "Business Informatics" at the Chair of Business Informatics and Mathematics at Industrial University of Tyumen, the full-time students (EB - 15 - 1 and EB - 15 - 2 groups) study the "Programming", where one of the academic performance rating methods is the course work writing and presentation at the end of the second term.

In the process of the course work check on the compliance with the requirements for the content, execution and absence of the matching content, the data presented in Table 1 have been obtained.

**Table 1**  
The Bachelor course works' Insights comparison

<b>№</b>	<b>Comparison criteria</b>	<b>Group EBb – 15 – 1</b>	<b>Group EBb – 15 – 2</b>
1.	The quantity of the students in the group	25	25
2.	The students who handed in the course work in time	18 (72%)	20 (25%)

3.	The students who draw up the title page correctly (as an example of the course work satisfactory form)	16 (64%)	17 (68%)
4.	The students who formulated the target of research correctly	16 (64%)	17 (68%)
5.	The students who formulated the research subject correctly	13 (52%)	13 (52%)
6.	The students who chose the standard topic	20 (80%)	19 (76%)
7.	The students who chose the substandard topic	5 (20%)	6 (24%)
8.	The students who fulfilled all requirements for the work content	13 (52%)	15 (60%)
9.	The theoretical analysis of the chosen topic essence categories	23 (92%)	22 (88%)
10.	A significant number of the references	15 (60%)	13 (52%)
11.	The research target process description	21 (84%)	22 (88%)
12.	The author's illustrated material	14 (56%)	15 (60%)
13.	The methodological foundations of the target analysis	19 (76%)	24 (96%)
14.	The methodological material from the related areas	10 (40%)	8 (32%)
15.	The average percent of the work text distinctiveness	75,2	78,3

Based on the above stated, it can be said that the Ebb – 15 - 1 group performance indicators are lower than the Ebb – 15 - 2 ones.

In both groups, one of the main mistakes is the incorrect formulation of the target and the subject of the research.

About 65% of all works are narrative, both the theoretical and the practical part of the course project. In 18 course projects out of 50 the content requirement percent is higher, in these works the author's contribution in the form of the categorical and classification apparatus comprehension, systematization and illustration should be noted.

In 18% of the works there is a theoretical chapter, based on the practical material, but at the same time the inconsistency of the material presentation is traced throughout the work. Instead of the scientific sources analyzing, a bibliographic review is provided, and the documentary basis for the course work is not enough. From a practical point of view, most of the studies are superficial, the conclusions reached are incorrect, the proposed recommendations have a weak argument.

The work design is also an important aspect of the course work writing. The normative control specialist noted the students' insufficient skills or their complete absence in using the Microsoft Word text editor and Microsoft Excel spreadsheets. None out of 50 students has been able to pass standard control from the first attempt and only 33% of the students have received a positive assessment for the course work design from the second or third attempt.

Another reason for the low course work evaluation is the students' inability to present their work. During the course work presentation, the students have showed the uncertainty, the poor knowledge of the theoretical material and they could not always answer the questions in a well-argued manner.

Using the methods of variance analysis, the authors analyzed the obtained results of the course work presentation in the "Programming".

In total, 25 evaluations have been analyzed in each of two groups, EBb - 15 - 1 and EBb - 15 - 2.

Group	Student №									
	1	2	3	4	5	6	7	8	9	10
EBb-15-1	3	2	3	3	3	4	2	4	3	5
EBb-15-2	4	3	2	3	4	5	3	4	3	5
Group	Student №									
	11	12	13	14	15	16	17	18	19	20
EBb-15-1	5	3	4	3	4	3	3	5	3	5
EBb-15-2	3	2	4	3	5	3	3	4	3	5
Group	Student №									
	21	22	23	24	25					
EBb-15-1	3	4	4	3	3					
EBb-15-2	3	2	3	4	3					

We have  $m = 2, n = 25$ . Let us find the average value of the obtained evaluations in each group by formula

$$\bar{x}_{i*} = \frac{1}{n} \sum_j x_{ij}$$

$$\bar{x}_{1*} = \frac{3 + 2 + \dots + 3 + 3}{25} = 3,48$$

$$\bar{x}_{2*} = \frac{3 + 4 + \dots + 4 + 3}{25} = 3,44$$

The average value of the obtained evaluations is calculated from formula

$$\bar{x}_{**} = \frac{1}{mn} \sum_{i=1}^m \sum_{j=1}^n x_{ij} = \frac{1}{m} \sum_{i=1}^m \bar{x}_{i*}$$

$$\bar{x}_{**} = \frac{3 + 2 + \dots + 4 + 3}{50} = 3,46$$

or, otherwise, through the group average

$$\bar{x}_{**} = \frac{3,48 + 3,44}{2} = 3,46$$

We calculate the sums of squared deviations by formulas

$$\sum_{i=1}^m \sum_{j=1}^n (x_{ij} - \bar{x}_{**})^2 = \sum_{i=1}^m \sum_{j=1}^n (\bar{x}_{i*} - \bar{x}_{**})^2 + \sum_{i=1}^m \sum_{j=1}^n (x_{ij} - \bar{x}_{i*})^2 + 2 \sum_{i=1}^m \sum_{j=1}^n (x_{ij} - \bar{x}_{i*})(\bar{x}_{i*} - \bar{x}_{**})^2$$

or

$$Q = Q_1 + Q_2.$$

Where

$$Q_1 = n \sum_{i=1}^m (\bar{x}_{i*} - \bar{x}_{**})^2$$

$$Q_2 = \sum_{i=1}^m \sum_{j=1}^n (x_{ij} - \bar{x}_{i*})^2$$

$$Q = \sum_{i=1}^m \sum_{j=1}^n (x_{ij} - \bar{x}_{**})^2$$

We obtain

$$Q_1 = 25 \cdot \sum_{i=1}^2 (\bar{x}_{i*} - \bar{x}_{**})^2 = 25 \cdot [(3,48 - 3,46)^2 + (3,44 - 3,46)^2] = 25 \cdot 0,0008 = 0,02$$

$$Q_2 = \sum_{i=1}^2 \sum_{j=1}^{25} (x_{ij} - \bar{x}_{i*})^2$$

$$= (3 - 3,48)^2 + (2 - 3,48)^2 + \dots + (3 - 3,48)^2 + (3 - 3,48)^2 + (4 - 3,44)^2 + (3 - 3,44)^2 + \dots + (4 - 3,44)^2 + (3 - 3,44)^2 = 38,4$$

$$Q = \sum_{i=1}^2 \sum_{j=1}^{25} (x_{ij} - \bar{x}_{**})^2$$

$$= (3 - 3,46)^2 + (2 - 3,46)^2 + \dots + (3 - 3,46)^2 + (3 - 3,46)^2 + (4 - 3,46)^2 + (3 - 3,46)^2 + \dots + (4 - 3,46)^2 + (3 - 3,46)^2 = 38,42$$

The corresponding number of the degrees of freedom for these sums  $m - 1 = 2 - 1 = 1$ ,  $mn - m = 2 \cdot 25 - 2 = 48$ ,  $mn - 1 = 2 \cdot 25 - 1 = 49$ .

<b>Variance components</b>	<b>Sum of squares</b>	<b>Degrees of freedom number</b>	<b>Average square</b>
Between-group	0,02	1	0,02
Intragroup	38,4	48	0,8
General	38,42	49	

The actually observed value of statistics  $F = \frac{S_1^2}{S_2^2} = \frac{0,02}{0,8} = 0,025$ . According to the table of applications, the critical value is the Fisher-Snedecor criterion at significance level  $\alpha = 0.05$  for  $k_1 = 1$  and  $k_2 = 48$  degrees of freedom  $F_{0,05;1;48} = 4,02$ . Since  $F < F_{0,05;1;48}$ , then at the significance level  $\alpha = 0.05$  (with a reliability of 0.95), it can be said that the difference in the knowledge level between the groups EBB - 15 - 1 and EBB - 15 - 2 is not significant.

At the meeting of the Chair of Business Informatics and Mathematics the results of the research have been gotten over the Head of the Chair and the higher-education teaching staff. The Head of the Chair O.M. Barbakov has drawn the well-argued conclusions that the student who is going to make a course work presentation must know the basics of the

scientific research planning, should be able to work with the scientific information and have the skills of the scientific research results competent formulation.

The Chair of Business Informatics and Mathematics teaching staff faced the question about the student competence development for the further course work and project presentations.

Since the course work presentation results of the Ebb – 15 - 1 group have been lower than the results of the Ebb – 15 - 2 group students, it has been proposed by the higher-education teaching staff, for the Ebb – 15 - 1 overall efficiency index increase, to organize and hold the "Research and Evaluation Fundamentals" elective during the third semester of training. The elective consists of 18 lectures and 18 practical classes with a credit test at the end of the term.

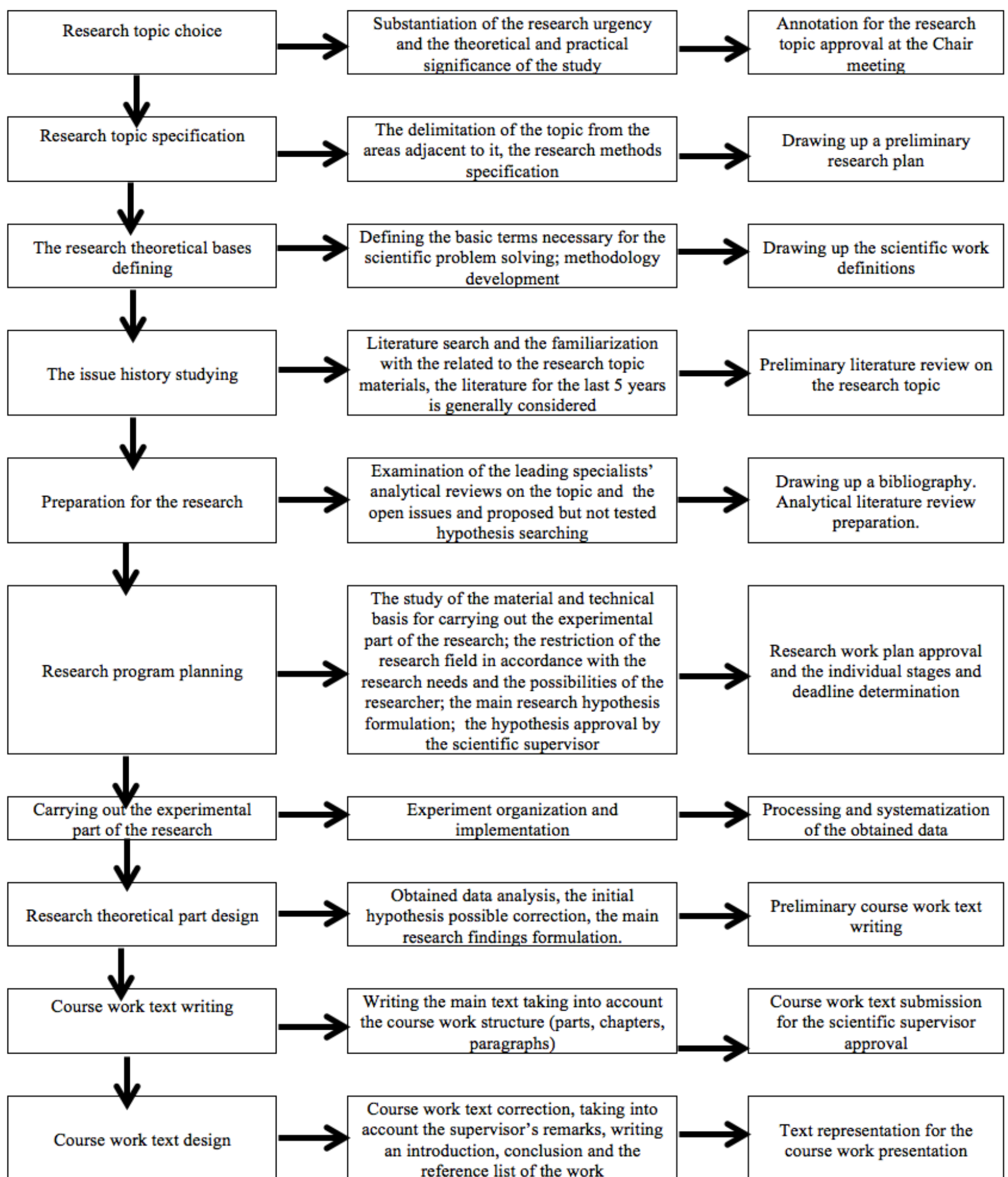
The "Research and evaluation fundamentals" elective is propaedeutical and is a kind of introduction of the students into the research work [6].

In the process of this elective studying, the students learn to formulate the task of the scientific information quantitative characteristics measuring, the history and the principal directions of the scientometrics development, the basis for the various scientific units' assessing and funding, the problems of using the scientometric assessment, citation ratio, the Hirsch index, and the online projects such as Web of Science, Scopus, Web of Knowledge, Russian Science Citation Index [2].

At the seminar classes the students are offered the learning activities on mastering the methods and procedures for the scientific research information searching, including the electronic library systems and catalogs using, on determining the scientific organizations and scientists' publication activity, on using the modern Internet services for the participation in the scientific conferences, the magazine article publication, including the application submission procedure, sending the article, acquaintance with the published materials and their bibliographic description compiling [3].

One of the most important topics of the seminar is the choice of the scientific research topic and the corresponding methodology for the research work planning [7].

The introduction of the scientific research planning principles to the students is organized by the lecturer according to the following scheme [4,5]:



### 3. Results

During the third term of study, the students of the Ebb – 15 - 1 group successfully mastered the theoretical and practical material of the "Research and Evaluation Fundamentals" elective, all 25 members of the group received a "credit" at the end of the course.

The "Research and Evaluation Fundamentals" elective study results have been tested in the fourth term of the training when writing a course project on the "Web - Design".

Using the variance analysis methods, the authors analyzed the obtained results of the course work presentation in "Web - Design".

In total, 25 evaluations have been analyzed in each of two groups, Ebb – 15 - 1 and Ebb – 15 - 2.

Group	Student №									
	1	2	3	4	5	6	7	8	9	10
EBb-15-1	4	4	4	4	4	5	3	5	4	5
EBb-15-2	2	4	3	4	4	4	3	4	3	4
Group	Student №									
	11	12	13	14	15	16	17	18	19	20
EBb-15-1	5	4	5	3	4	4	4	4	4	5
EBb-15-2	3	3	4	3	4	3	3	4	3	4
Group	Student №									
	21	22	23	24	25					
EBb-15-1	4	5	4	5	4					
EBb-15-2	3	3	2	3	3					

After the experiment, let us find the average value of the obtained evaluations:

$$\bar{x}_{1*} = \frac{4 + 4 + \dots + 5 + 4}{25} = 4,24$$

$$\bar{x}_{2*} = \frac{2 + 4 + \dots + 3 + 3}{25} = 3,32$$

The average value of the obtained evaluations:

$$\bar{x}_{**} = \frac{4 + 4 + \dots + 3 + 3}{50} = 3,78$$

The sums of squared deviations are:

$$Q_1 = 25 \cdot \sum_{i=1}^2 (\bar{x}_{i*} - \bar{x}_{**})^2 = 25 \cdot [(4,24 - 3,78)^2 + (3,32 - 3,78)^2] = 25 \cdot 0,4232 = 10,58$$

$$Q_2 = \sum_{i=1}^2 \sum_{j=1}^{25} (x_{ij} - \bar{x}_{i*})^2$$

$$= (4 - 4,24)^2 + (4 - 4,24)^2 + \dots + (5 - 4,24)^2 + (4 - 4,24)^2 + (2 - 3,32)^2 + (4 - 3,32)^2 + \dots + (3 - 3,32)^2 + (3 - 3,32)^2 = 18$$

$$Q = \sum_{i=1}^2 \sum_{j=1}^{25} (x_{ij} - \bar{x}_{**})^2$$

$$= (4 - 3,78)^2 + (4 - 3,78)^2 + \dots + (5 - 3,78)^2 + (4 - 3,78)^2 + (2 - 3,78)^2 + (4 - 3,78)^2 + \dots + (3 - 3,78)^2 + (3 - 3,78)^2 = 28,58$$

<b>Variance components</b>	<b>Sum of squares</b>	<b>Degrees of freedom number</b>	<b>Average square</b>
Between-group	10,58	1	10,58
Intragroup	18	48	0,375
General	28,58	49	



The actually observed value of statistics  $F = \frac{S_1^2}{S_2^2} = \frac{10,58}{0,375} = 28,21$ . According to the table of applications, the critical value is the Fisher-Snedecor criterion at significance level  $\alpha = 0.05$  for  $k_1 = 1$  и  $k_2 = 48$  degrees of freedom  $F_{0,05;1;48} = 4,02$ . Since  $F > F_{0,05;1;48}$ , then at the significance level  $\alpha = 0,05$  (with a reliability of 0,95) it can be said that the difference in the knowledge level between the Ebb – 15 - 1 and Ebb – 15 – 2 groups is significant.

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## 4. Discussion

After the presentation results analyzing, the following improvements during the course project writing have been highlighted by the author:

- most of the works are exploratory;
- the theoretical part is presented correctly;
- there is a deep analysis, a logical, consistent material presentation with the relevant conclusions and the reasoned proposals that are of considerable practical importance;
- the work design corresponds to the current standards, and is accompanied by a sufficient amount of the tabular and graphic matter.

In the process of the course project presentation, the students showed a deep knowledge of the theoretical material, they could freely manipulate the data of the practical part of the research, they used the visual aids, gave clear and reasoned answers to the questions posed by the members of the commission.

This study showed that the organization and realization of the "Research and Evaluation Fundamentals" elective has had a significant impact on the increase of the course work presentation average grade of the Ebb - 15 - 1 group.

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## 5. Conclusion

The results of the research have been announced at the meeting of the Chair of Business Informatics and Mathematics.

The Educational and Methodological Board of the Chair raised the issue of including the "Research and Evaluation Fundamentals" elective in the curriculum.

Thus, since 2017 academic year the "Research and Evaluation Fundamentals" elective has been included in the curriculum of the "Business Informatics" bachelor degree course, in the "Electronic Business" specialization.

This elective is hold in the third term of study, it consists of 18 lectures and 18 practical classes with a credit test at the end of the term.

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