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QUANTITATIVE CALCULATION OF THE QUALITY OF TEACHING AS A PROJECT MANAGEMENT FACTOR OF THE INTERNATIONAL CONTRACT

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Abstract

One of the most problematic places in the implementation of international contracts is inefficient project management. The choice of inappropriate methodology for managing the educational project, irrational allocation of resources, untimely monitoring quality of the provided services can lead not only to the loss of an existing contract, but also to the reduction of the university's reputation in the international arena in conditions of competitive struggle in the educational services market. In turn, this minimizes the probability of concluding of new contracts.

An innovative methodology for managing projects for the provision of educational services to a foreign customer has been developed. A general calculation of the quantitative assessment of a quality of the provision of an educational service is applied in this methodology. In order to significantly reduce the calculation time was created a universal computational program that allows processing of large data blocks with visualization of results in a two-dimensional coordinate system. The methodology was implemented in the NUOS workflow.

The obtained results make possible to control the quality of rendering educational services to a foreign customer with minimum expenses of human resources and make adjustments to the educational process quickly if it necessary.

Keywords: Universal Computing Program; Quantitative Quality Assessment; Principal Project Management Approaches; International Educational Program.

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1. Introduction

Entering the international education market Ukrainian higher educational institutions face a serious competitive struggle not only for attracting citizens of other countries for training, but also for the struggle for a Ukrainian entrant, who increasingly looks toward European universities. In such conditions, the orthodox methods of work of the admission commissions do not always give the necessary results and without a creative approach can not be dispensed with.

Special attention should be paid to applicants from the People's Republic of China. China ranked first in the world in terms of the number of citizens going abroad every year according to the "Report on the development of Chinese students studying abroad" (Research Center of China and globalization, Academy of Social Scienes of China, 2013). The number of Chinese students abroad is 14% of the world's total according to UNESCO statistics, what is turning China into the largest provider of foreign students.

2. Object of Research and its Technological Audit

The subject of the study is contract No. 2/16 for training Chinese citizens at the Admiral Makarov National University of Shipbuilding (NUS). Foreign students are a source of additional funding in terms of financial and economic activities of universities. As a result, there is a serious between Ukrainian universities for attracting foreigners for training, using various mechanisms of competition.

One of the most problematic places in the implementation of international contracts is inefficient project management. The choice of inappropriate methodology for managing the educational project, irrational allocation of resources, untimely monitoring quality of the provided services can lead not only to the loss of an existing contract, but also to the reduction of the university's reputation in the international arena in conditions of competitive struggle in the educational services market. In turn, this minimizes the probability of concluding of new contracts.

3. Purpose and Objectives of Research

The aim of the work is to make a quantitative calculation of teaching quality on the international Contract No. 2/16 within the framework of the innovative methodology of project management for the provision of educational services to a foreign customer.
The following tasks were accomplished in order to achieve the set aim:
1) Semester control of the quality of students' training was conducted.
2) Students were questioned about the quality of teaching.
3) Quantitative calculations of the quality of teaching in the universal computing program are performed.

4. Presentation of the Base Material

Accumulated many years of NUS experience with international customers makes it possible for a rational approach creation for the project management of the foreign segment. Existing management models do not fully meet their stated objectives for the implementation of these projects. In particular, the closest models: traditional (cascade) project management methodology is not suitable because of its inertness and intolerance to changes, and popular in the west methodology PRINCE2 would make a lot of additional bureaucratic claims (Guay, 2017), 01 (Papke-Shields & Kathleen, 2017).

Based on the results of the project management performed by Educational Scientific Centre of International Cooperation of NUS the project management methodology to provide the educational services to the foreign customer has been developed (Project Management for Education, PME) (Ryzhkov, 2016). The processes of PME-methodology are shown in Figure 1.

The principles of the PME-methodology:

1) **Possibility Assessment, selection of performers -** whether the university is able to complete an international project in accordance with the requirements of the customer, in the case of a positive assessment the necessary university structural units are picked and the team of project executors is being formed.
2) **The continuous growth -** to take into account the wishes of the customer, to accumulate experience.
3) **The use of the mechanism of "shared responsibility" -** the responsibility for a positive outcome of the project is not only the main executor headache (in common, the international structural unit of the university is the main executor), but also it is a responsibility of all other structural units that are involved in the project.
4) **Evaluation of the quality of work -** maintaining an unprejudiced control over the quality of educational services provided by the university. The constant desire to improve and meet the high international standards.
5) **Sectoral project management -** project is divided into blocks (sectors), every sector has its executing team.

Aspects of the PME-methodology:

1) **Planning -** preparation for implementation of the project, verification of curricula, preparation of supporting documents, dispatching support.
2) **Co-ordination -** the allocation of responsibilities, the matching of structural divisions.
3) **Execution -** the level of compliance of planned results to the actual implementation.
4) **Risks -** mechanisms to solve possible contingencies in the planning and the factors of external interference.

The processes of PME-methodology:

1) **Rector's control.**

Rector, or its authorized person conducts supervision over the implementation of the University obligations to the international customer. It is implemented throughout the project period.

2) **Start of the project.**

The reason for the start of the project is the international contract for the provision of educational services. It is also the plan of the project. At this stage of the project the responsible executors are appointed and all preparatory work is carried out.

3) **Project Management.**

This stage is characterized by the distribution of sectoral responsibility.

4) **Implementation of the project.**

The fundamental stage of the project, which is a direct provision of educational services to international students/trainees by basic university divisions - departments.

5) **Monitoring of progress.**

At the expiration of the specified time period, a comprehensive monitoring of the implementation of the project to identify abnormalities and other negative factors that can hinder the implementation of the contract is being performed. Usually selected time period is a educational semester.

6) **Quality of teaching monitoring.**

Implemented together with the control performance and is aimed at compliance with international teaching criteria.

7) Completion of the project.

It is characterized by the implementation of terms and conditions of the contract with the issuance of diplomas/certificates to foreign citizens who have completed all requirements for the assignment of corresponding qualification.
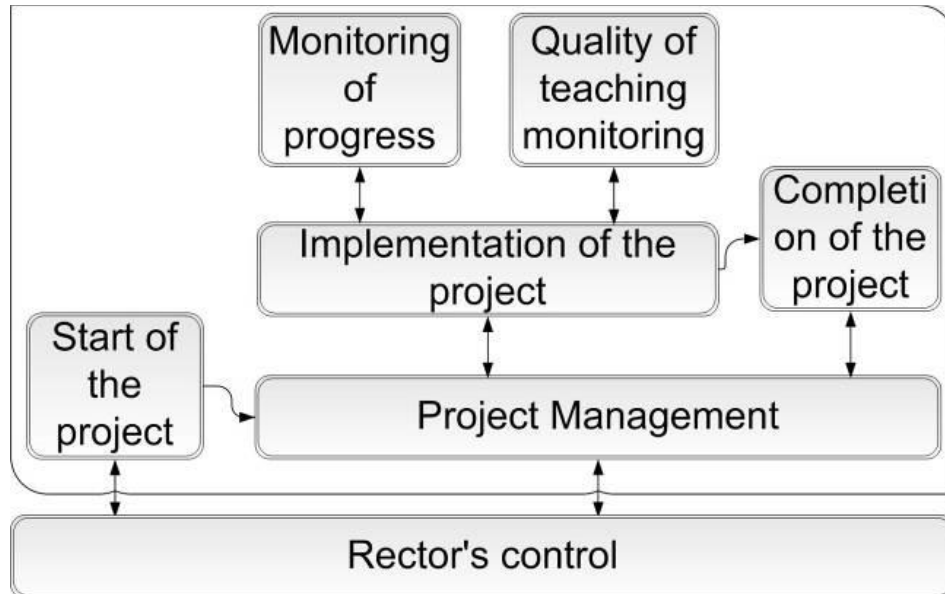

Figure 1: The processes of project management methods to provide educational services to the foreign customer

As part of improving the PME-methodology, universal computing program (UCP) for calculation of a quantitative assessment of the quality of teaching in educational establishment has been developed on the basis of improved by author mathematical model that is defined by the dispersion of average score and calculated as the weighted arithmetic mean of score dispersion for each discipline, with quantitative measure calculated as the return value to the quadratic coefficient of variation.

For a quantitative assessment of the quality of teaching is taken adjusted average score, that students have received as a result of the final control on discipline that is taught by concrete teachers in the semester.

Average score that students have received as a result of final control in all disciplines of k-teacher, calculated as an average weighted from average scores in each discipline as follows:

$$\overline{X}_k = \frac{\sum\limits_{1}^{m} X_j \times f_j}{\sum\limits_{1}^{m} f_j}$$

Where Xj – average score that students received from k-teacher of the j-discipline in the observed period;
fj - the amount of j-discipline credits in the observed period;
m - number of disciplines.

Spread of students' scores is taken into account by dispersion of average score, earned by students as a result of final control in all disciplines of k-teacher. Dispersion is calculated as weighted arithmetic mean of the scores dispersion for each discipline as follows:

$$\overline{\sigma_k^2} = \frac{\sum_1^m \sigma_j^2 \times f_j}{\sum_1^m f_j}$$

Where σ_j^2 - dispersion of the scores that have been received by the students of k-teacher in j-discipline in the observed period, which is calculated using the formula:

$$\sigma_j^2 = \frac{\sum_1^S (X_j - X_l)^2}{S}$$

Where Xl - score, received by i-student from k-teacher in the j-discipline in the observed period;
S - quantity of students who studied from k-teacher of the j-discipline for the observed period.

Relative indicator Ωk that quantifies the quality of the k-teacher as a result of the final control of all disciplines is calculated as inverse to the quadratic coefficient of variation:

$$\Omega_k = \frac{\overline{X_k}}{\overline{\sigma_k}}$$

Rating score of the quality of work at the University of k-teacher calculated as follows:

$$R_k = \frac{\Omega_k \times F_k}{\sum_1^n \Omega_k \times F_k}$$

Where Fk - the quantity of credits that was given by k-teacher for the observed period;
n - number of teachers of the institution (or its structural unit) for the observed period.

The results of implementation of this calculation to working process of Educational and Scientific Center of International Cooperation of the Admiral Makarov National University of Shipbuilding has brought to conclusion, that this calculation requires adjustments. In particular, it does not reflect the opinion of the student. Therefore, the questionnaire was developed to evaluate the teachers work by students (Table 1).

Table 1: Questionnaire evaluation of teachers by students

Evaluate the teacher work _____ on discipline _____		for each question put one mark from 0 to 10
1	Knowledge of the subject	
2	Proficiency in English (or other working language of the subject)	
3	The ability to explain clearly the material	
4	A common language with the student, the ease of communication	
5	Demands to the knowledge level, which was received by the student	
6	How interesting this subject concrete for you	
7	To your mind, how the knowledge of the subject will be useful to you in the future	
8	How honestly and impartially teacher evaluates your knowledge	
9	The attitude of teacher to the labor discipline	
10	Would you like this teacher to continue teaching you in next semester	
	The sum of marks	

Student _____ group _____ (optionally filled)

The relative scale of marks of teacher work for each question:	0 - you are not sure that this person is able to teach 1 - absolutely not doing his/her task 2 - very bad coping with his/her task 3 - badly coping with his/her task 4 - partly coping with his/her task 5 - below average coping with his/her task 6 - medium coping with his/her task 7 - normally copes with his/her task 8 - well coping with his/her task 9 - very well coping his/her task 10 – perfectly coping with his/her task

As a result of a survey of students the corrective calculations of quantitative assessment of the quality of teaching.

Spread of teachers' scores is taken into account by dispersion of average score, that was evaluated by students as a result of a survey of k-teacher. Dispersion is calculated as follows for ranged set (not grouped data) for each discipline:

$$\sigma_s^2 = \frac{\sum_{1}^{S}(X_s - X_{ls})^2}{S}$$

Where Xs – average score that students evaluated for k-teacher of the j-discipline in the observed period;
Where Xls - score, that i-student evaluated for k-teacher in the j-discipline in the observed period;
S - quantity of students who studied from k-teacher of the j-discipline for the observed period.

Relative indicator Ωs that quantifies the quality of the k-teacher as a result of a student's survey of all disciplines is calculated as inverse to the quadratic coefficient of variation:

$$\Omega_s = \frac{\overline{\overline{X_s}}}{\sigma_s}$$

Rating score from students' survey of the quality of work at the University of k-teacher calculated as follows:

$$R_s = \frac{\Omega_s}{\sum_1^n \Omega_s}$$

n – quantity of teachers of the institution (or its structural unit) for the observed period.

Thus, overall rating score of quality in higher educational establishment of the k-teacher will be calculated by the arithmetic mean of the final control rating and rating on students survey in the observed period:

$$R_{ks} = \frac{R_k + R_s}{2}$$

The total sum of ratings of all teachers of the institution (or its structural unit) for the observed period equal one.

5. Research of Existing Solutions of the Problem

The methodology of teaching in assessing the quality of teaching should be taken into account. There is a world trend in the orientation of education directly to the solution of production problems, neglecting the issues of intellectual and moral development of society based on the latest research in this field (Gutiérrez & Villegas, 2015). A number of project management studies points to the project approach as a methodology for building a modern university education (Serikov, Pichugina, & Saurenko, 2015). Repeatedly, the importance of multi-criteria evaluation in assessing the quality of education was pointed out. Also emphasizes the complexity of the evaluation of teaching and the causal relationship between the evaluation of learning outcomes in higher education and the quality of higher education (Ďurišová, Kucharčíková, & Tokarčíková, 2015). The well-known European model for assessing the competence of personnel based on the standard competency model has flexible tools for examination in real corporate environments for the evaluation of employees, but does not fully meet the task of monitoring the quality of teaching for foreign citizens (Bohlouli, Mittas, Kakarontzas, Theodosiou, Angelis, & Fathi, 2017).

It is suggested that the teacher be regarded as a person who aspires to help the student to acquire the necessary knowledge and skills required by the education standard in the NUOS. Calculation of the quantitative evaluation of the quality of teaching is based on this approach (Ryzhkov O. , 2017). This calculation was used to assess the educational process for Ukrainian students, but it is used to assess the implementation of international training programs for the first time. The literature does not contain data about the existence of a universal computational program for calculating the quantitative assessment of the quality of teaching. Therefore, the program was developed on the basis of a package of MatLab application programs to simplify the calculation

process (The MathWorks, Inc., 2017). In this program were carried out multiple calculations for the management of the quality of education in the NUS. A methodology for managing the project to provide educational services to an international customer has also been developed (Ryzhkov O. , 2017).

6. Methods of Research

A universal computational program was developed for calculating the quantitative assessment of the quality of teaching as part of the development of the project management methodology for providing educational services for a foreign customer.

The adjusted average score that the students received as a result of the final control of the discipline presented by this teacher for a semester was taken as a quantitative assessment of the quality of teaching.

As practice has shown this calculation requires adjustment. In particular, it does not reflect the constituent part of the student's opinion, which is provided with an educational service, as a final link. Therefore, a questionnaire was developed for assessing the work of the teacher by students. A universal computational program was created for calculations for a significant reduction of time. This program allows to process large data blocks with the visualization of results in a two-dimensional coordinate system. This program, which controls the quality of the provision of educational services for international customers, was introduced into the work process of the Educational and Scientific Center of International Cooperation (ESCIC) of the Admiral Makarov National University of Shipbuilding.

The general interface of the universal computational program for calculating quantitative assessment of the quality of teaching with division into blocks and graphs is shown in Fig. 2. The data of teacher's assessments are entered in the fields of the first calculation block of the program. The algorithm of the block allows calculating the estimates of the group to 45 students at the same time. After the ratings are entered, click the "Calculation" button. Next, you will see the results of calculating the average score, the variance (the standard deviation), and the relative quality score in the corresponding fields.

The results of the calculation for comparing the average total score with the grades for the individual student are also output in the first graphic block. We carry out the same operation for each discipline.

In the second settlement block, we enter the number of credits for each of the disciplines that are analyzed. The results of the calculation according to the teacher's assessment of the relative quality score from the first block are entered in the appropriate fields. After clicking the "Calculate Rk" button, the teacher ratings are displayed in the corresponding fields Rk and in the second graphic block.

The results of the calculation according to students' assessments of the relative quality index from the first block are entered in the corresponding fields in the third calculation block. After

clicking the "Calculate Rs" button, the results of the teachers rating are displayed in the corresponding fields Rs and in the second graphic block.

We press the button "Calculation Rks" after all calculations on the second and third blocks are carried out. The results of the final rating of teachers are displayed in the corresponding fields Rks and in the second graphic block.

Figure 2: General interface of the universal computing program

7. Research Results

A calculation of the quantitative assessment for a group of Chinese students under the Contract No. 2/16 was made as a quality control of teaching. The work shows the calculation of the evaluation of teaching for the seventh semester of 2016., A group of 15 students was provided with an educational service in 7 disciplines during this period:
j1 – The Theory of the Ship and Means of Development of Ocean;
j2 – Materiality and Technology of Constructional Materials. Basics of Welding Engineering;
j3 – Design of Ship and Sea Technique;
j4 –Technology Basics of Shipbuilding and Sea technique;
j5 – CAD, CAE, CAM Systems in Shipbuilding
j6 – English Languge;
j7 – Russian Language.

Lecture, practical and laboratory classes in these disciplines were provided by a team of 10 teachers. In some disciplines, lecture material was read by one teacher, and practical and laboratory classes were taught by another teacher. In this case, the qualitative assessment of teaching was calculated for a specific discipline and characterized by a team of teachers working in this way in pairs.

Tables 2 and 3 show the results of the semester control of progress and the results of the questioning of students, respectively. The study period is 7th semester 2016.

Table 2: Results of the monitoring of academic performance on the contract No. 2/16 for the 7th semester of 2016							
Stud No	j1	j2	j3	j4	j5	j6	j7
1	64	78	77	76	100	74	69
2	81	85	72	74	96	90	64
3	94	86	92	68	100	81	90
4	74	76	90	75	90	90	90
5	82	73	75	70	96	81	64
6	76	91	72	95	100	90	90
7	96	79	94	80	100	74	60
8	78	72	81	71	100	81	84
9	96	88	87	74	100	81	78
10	74	65	83	80	100	89	85
11	82	71	86	90	100	100	90
12	64	62	76	75	96	74	81
13	64	63	62	80	65	90	60
14	100	90	95	95	100	90	64
15	86	97	91	100	96	100	83

Table 3: The results of the questionnaire on the contract No.2 / 16 for the 7th semester of 2016							
Stud No	j1	j2	j3	j4	j5	j6	j7
1	87	93	100	94	100	97	92
2	90	100	98	100	94	99	100
3	100	84	100	70	70	98	70
4	75	96	100	94	78	100	93
5	85	95	98	100	100	100	90
6	100	100	100	93	82	100	100
7	98	100	100	94	100	95	90
8	100	99	100	100	100	100	99
9	100	96	100	100	99	100	100
10	96	100	89	98	99	98	94
11	90	100	80	100	98	100	97
12	100	98	85	99	100	78	98
13	100	99	95	95	100	98	100
14	95	100	100	96	99	100	96
15	-	-	-	-	96	92	87

The results of the calculations of the quantitative assessment of teaching in 7 disciplines for the 7th semester of 2016 under contract No. 2/16 for the training of PRC citizens are shown in Fig. 3 and in Table. 4.
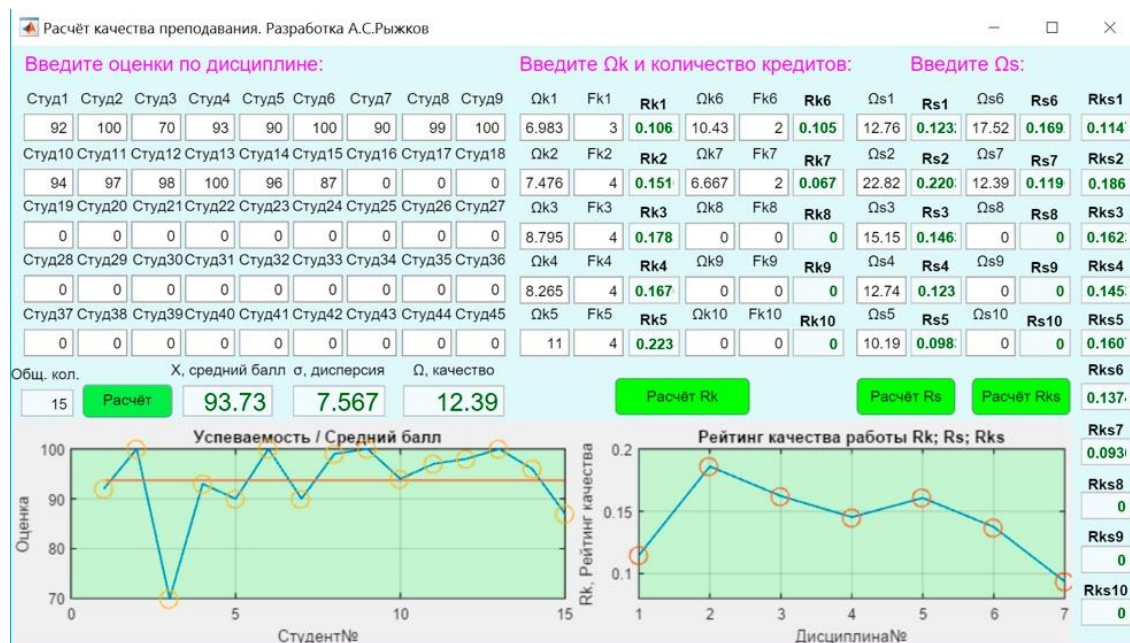

Figure 3: The result of calculating the quantitative assessment of the teaching quality in the universal computing program for 15 Chinese students for the 7th semester of 2016

Table 4: Results of calculations of the quantitative assessment of teaching in 7 disciplines for the
7th semester of 2016 on the contract No. 2/16

Rating	j1	j2	j3	j4	j5	j6	j7
Xj	80.73	78.4	82.2	80.2	95.93	85.67	76.8
Xs	94	97.14	96.07	95.21	94.33	97	93.73
fj	3	4	4	4	4	2	2
Fk	3	4	4	4	4	2	2
σ_j	11.56	10.49	9.347	9.704	8.721	8.211	11.52
σ_s	7.368	4.257	6.341	7.475	9.257	5.538	7.567
Ωk	6.983	7.476	8.795	8.265	11	10.43	6.667
Ωs	12.76	22.82	15.15	12.74	10.19	17.52	12.39
Rk	0.1062	0.1516	0.1783	0.1676	0.223	0.1057	0.06759
Rs	0.1232	0.2203	0.1463	0.123	0.09839	0.1692	0.1196
Rks	0.1147	0.186	0.1623	0.1453	0.1607	0.1374	0.09361

It is possible to make an initial conclusion about the quality of teachers work as a result of final
control in all disciplines by analyzing the results of the quantitative characteristics obtained with
respect to the relative Ωk index (Figure 4). The highest quality of the educational service was
provided according to the discipline according to the results of the rating score, based on the
teacher's semester control of academic achievement (Fig. 4), j5 – CAD, CAE, CAM systems in
shipbuilding (Rk=0,223). Then follows discipline j3 – Design of Ship and Sea technique
(Rk=0,1783), and then j4 –Technology Basics of Shipbuilding and Sea technique (Rk=0,1676).
The worst indicator of discipline j7 – Russian Language (Rk=0,06759), a bit better j6 – English
Language (Rk=0,1057); behind it j1 – The Theory of the Ship and Means of Development of
Ocean (Rk=0,1062).
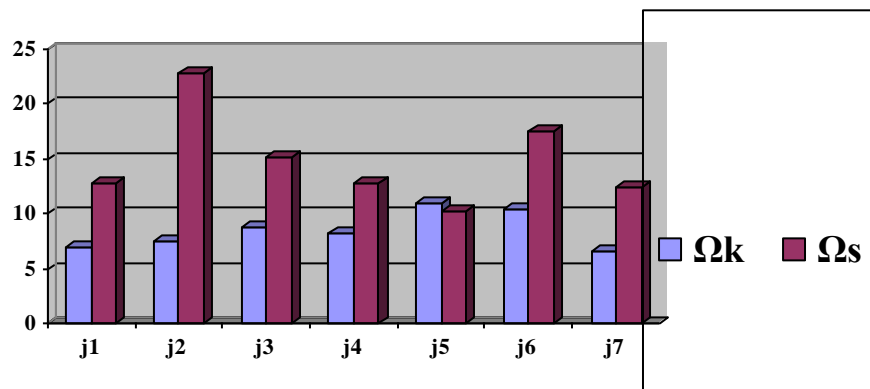
Figure 4: Relative Ωk indicator, which quantitatively characterizes the quality of work of
teachers in 7 disciplines for the 7th semester of 2016 on the contract No.2/16.

The final rating is different from the original as a result of the clarifying calculation on the
questionnaire of students. The highest quality of the educational service was represented in
discipline j2 – Materiality and Technology of Constructional Materials, Basics of Welding
Engineering (Rks=0,186) as seen in Fig. 5. Then follows discipline j3 – Design of Ship and Sea
technique (Rks=0,1623), and then j5 – CAD, CAE, CAM systems in shipbuilding (Rks=0,1607).
The worst indicator remained in the discipline j7 – Russian Language, but its rating has grown
significantly (Rks=0,09361); second place from the end received discipline j1 – The Theory of

the Ship and Means of Development of Ocean (Rks=0,1147) a bit better j6 – English Language (Rks=0,1374).
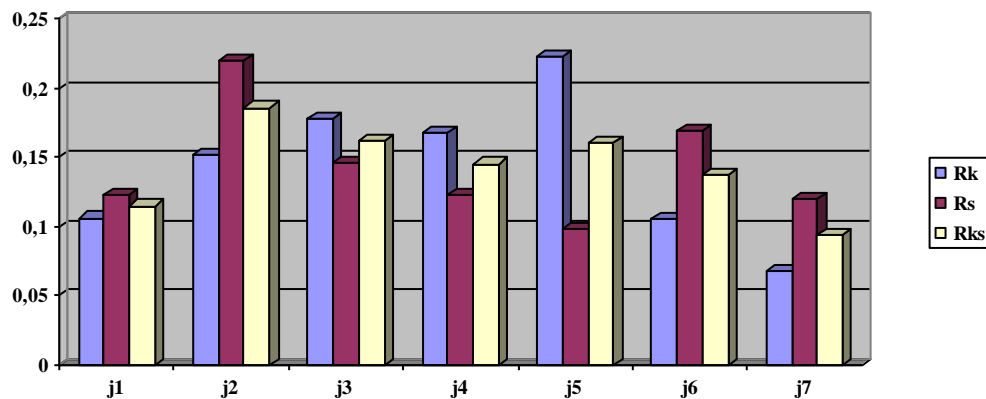

Figure 5: The rating score of the quality of the work of teachers in 7 disciplines for the 7th semester of 2016 on the Contract 2/16.

All disciplines satisfy the condition of a high standard of training (R≥0.06). Thus, seven of the seven taught disciplines met the necessary criteria. The task before the international customer on the Contract 2/16 was fully implemented for this period of time.

8. Conclusions

1) Based on the results of the project management performed by Educational Scientific Centre of International Cooperation of NUS the project management methodology to provide the educational services to the foreign customer has been developed (Project Management for Education, PME).

2) This methodology allows to effectively manage international educational projects, which is confirmed by its application in a successful implementation of a number of international contracts of NUS.

3) Summing up main NUS international curricula, we can conclude that the similar fundamental approaches of project management can be applied for other international projects despite their differences. They are also applied for various existent programs or programs which are planned to be fulfilled by the higher educational establishments of the world.

4) In order to develop the project management methodology to provide the educational services to the foreign customer was created a working version of a universal computing program (UCP) based on an improved method of calculation of a quantitative assessment of the quality of teaching. UCP can handle large blocks of data with visualization of a results in a two-dimensional coordinate system. The use of UCP leads to a significant reduction in time spent of executors of international contracts to meet the challenges of quality management educational services provision.

5) It is customary to make calculations in an universal computing program that allows processing large data blocks with visualization of results in a two-dimensional coordinate system as a part of the development of the project management methodology for

providing educational services for a foreign customer, in order to significantly reduce the costs of temporary resources for assessing the quality of teaching.

6) Comprehensive calculations of the quantitative assessment of the quality of the provision of educational services by teachers were conducted in Admiral Makarov National University of Shipbuilding on the Contract 2/16 with Zhejiang International Maritime Collede.

7) All disciplines satisfy the condition of a high standard of learning based on the results of calculations (R≥0.06). Thus, seven of the seven taught disciplines met the necessary criteria. The task before the international customer on the Contract 2/16 was fully implemented for this period of time.

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