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V.V. Oshchapovskii, cand. chem. sci, docent
(Lviv State University of Safety of Vital Activity)
V.V. Shylo, cand. phil. sci., docent
(Ivan Franko Lviv National University)

CONSIDERATION OF STUDENTS' ACADEMIC ACHIEVEMENTS WHEN DRAWING UP THEIR PERFORMANCE SCORE

The article analyses the assessment of students' performance during the educational module. A new universal formula offered for the evaluation of the knowledge takes into account the students activity in educational process as well as other parameters of their behavior:

$$\text{mod} = \text{ave}_{\text{prac}} + \text{ave}_{\text{lab}} + \text{MCW} + (\text{PO} + \text{ZS})^{\text{PO}/(Z-1)}[\text{PO}/(Z-1)]^{1/\text{ZS}} \cdot$$

It will allow to promote the efficiency of teaching of students, including student in subdivisions of Ministry of Emergency of Ukraine.

Key words: Bologna system; students' performance; assessment

In the system of preparation of specialists-chemists as well as other related specialities large attention is paid to teaching the fundamentals of chemistry, which include the basis of general, organic, and physical chemistry etc.

An increase in efficiency of the process of student teaching in higher school constitutes an objective factor of the continuous scientific and technical progress of the society. The necessity to perfect the system of higher and special education including the use of the Bologna system of education in preparation of modern specialists reflects a result and consequence of new educational tendencies in the world, competitions of leading countries and their methods of specialist preparation, competitions of leading world institutes in a fight for a man-specialist (manager,

engineer, scientist) of the XXI century and finally – for hegemony in a fast-developing world. Similarly to the new systems in science as well as in pedagogics, the Bologna' system of education has certain drawbacks, inaccuracies in determination approaches, module assessment and, finally, evaluation of the general progress of student achievement during studies.

One of the basic drawbacks of the well-known methods of assessment is the negligence of student's performance during his studying.

Namely a final assessment of a student progress based on the results of the module constitutes the major stage in an independent evaluation of the general volume of received and consolidated knowledge. The credit module (module of ECTS) is a part of educational (multisemester) discipline, which is studied in a certain semester [9]. In other words, the module is either a complete volume of information, which is necessary to be mastered by a student, or a completed volume of learning activity, which must be performed by a student. However, there are indications on the absence of a single format of the module. Unfortunately, nowadays, a quantitative assessment based on the results of the module is not always objective and is somewhat inaccurate and subjective due to absence of clear basis of assessment of the activity of the student, different amount of educational load, structure of lessons etc. (These questions are considered in greater detail in monographs and articles [1,3,5,6,7,8]). This results in a certain (often essential) error in the objective assessment of knowledge and abilities of the student, his motivation, purposefulness, desire to acquire and use new information of the studied discipline. The general rules, provisions, criteria of final control in accordance with which the general organization of educational process is carried out in a finished period of education, are indicated in the list of literature [8]. Every university solves a similar problem independently and automatically, taking into account its own conceptual positions [1], traditions, structure, contingent of students etc. However, the question of forming the final assessment of student knowledge is obviously tackled not enough. Meantime, the imitation of the European systems of assessment is not always rel-

evant and can result in the decrease of fundamental nature and quality of knowledge as well as leveling of teachers' high professionalisms. Moreover, the attempts to perfect the system of assessment of education quality in most cases result in its unjustified overstating [2].

A few words about the assessment of knowledge in universities of Ukraine. The usual system of knowledge assessment consists of 5 grades (points). The highest estimation is **5** (excellent), **4** – good, **3** – satisfactory. The last one is **2** (unsatisfactory). Formally a student can be assessed with **1** for very bad knowledge.

However, this system of assessment does not motivate the student for continuous learning: very often a student getting a few satisfactory points considers his task completed and will not show educational activity and diligence further on. In this situation the teacher does not have a strict quantitative or mathematical possibility to stimulate the student for further perfection in learning. All these well-known stimuli refer to the remote future of the student (his future work) and are not always effective. Therefore, the final assessment of student knowledge bears certain amount of subjectivity, formality, presupposes various indulgences and preferences or, vice versa – faultfinding. However, an objective assessment requires a maximally independent evaluation and simultaneous consideration of all quantitative indexes (factors, parameters) shown by the student during the process of learning.

To increase the efficiency of teaching of students it is worth utilizing the ideas and works of cybernetics, which studies the systems, their features and laws of conduct. In our view, when using the language of cybernetics there should be reverse connection in the educational system "teacher – student", which will allow to maximize the co-operation between these components of the given system, will strengthen student's zeal, will show him clearly where and how it is possible to gain additional points for a final assessment of the module.

The work suggests a new approach to the evaluation of knowledge, removal of drawbacks and, what is the most essential – taking into account the activity of acquisition and demonstration of knowledge mastered by a student according to a character of the Bologna system of education. It is especially valuable when it is difficult to perform due to scarce or considerable amount of multiform knowledge, when there is a comparative possibility for a student to show his knowledge and achievements. It is important for educational disciplines as well. They are saturated with quite difficult and diversified types of knowledge, for example, practical tasks, laboratory work, specific heterogeneous technical features characteristic for preparation of the specialists of the widest type. It was always peculiar for workers related to chemistry and chemical engineering as well as cognate activities: environmentalists, biologists, geologists etc.

Let us consider the existing system of assessment (summing up the results of the module control). According to the well-known provisions of the Bologna System [2,6,7,9] a module evaluation includes a current assessment at practical (laboratory) classes, points for a final course work (if planned) and final test (it constitutes, as a rule, 60-70% of the general quantity of points for the module). The extra charge of additional points for writing of essays, scientific reports, "penalty" points for missing classes etc. are also possible. The main drawback of such assessment, in our point of view, is the absence (or slight subjective) consideration of student activity at the lesson since the current assessment provides at best the arithmetical mean. The latter can be achieved as an average from 1-2 estimations for the whole module, i.e. 1.5-2 calendar months, which is not always reliable and statistically meaningful.

In order to remove this drawback and take into account educational activity of the student the general assessment for the module should be formed in the following way.

One can assume that the final assessment for the module (1.5-2 months of study) should be equal to 50 points. If a semester consists of 2 modules, the general sum of points for a semester equals to 100 [9]. Then the general module assessment should include: 1) arithmetic mean assessment of knowledge for the given period (i.e. includes arithmetic mean of the current check) according to the results of practical and laboratory classes; 2) assessment of the course work – from 5 to 10 points; 3) assessment of the final module test (60-70% from the general sum of points for the module, which

constitutes 30-35 points). Besides, 4) is represented by the assessment for the general activity of the student (**A**) during all the classes of the module. This last assessment takes into account student's progress and the number of classes attended. In our previous works these aspects were not considered precisely. Upper limit to A quantity was modified by an arbitrary and insufficiently justified number 10 [3]. Formula component connected with students' attendances was not clearly defined in another work [4]. This article suggests considerable corrections of those deficiencies and calculation of the student performance score according to a more definite and corrected empirical formula:

$$\mathbf{A} = (\mathbf{PO} + \mathbf{ZS})^{\mathbf{PO}/(\mathbf{Z}-1)}[\mathbf{PO}/(\mathbf{Z}-1)]^{1/\mathbf{ZS}} \qquad (1)$$

wherein '**PO**' is an amount of positive estimations in the course of a module (i.e. at current estimations 4, 3 and 5 – '**PO**' = 3). '**Z**' represents a general amount of knowledge during the module. It is reduce twice as it is presupposed that one class should be allowed to conduct a course work and the other one – to conduct final module test (in case course work is not foreseen, figure Z will reduce). **ZS** – a number of classes attended by the student. The expression of power for correlation "**PO/(Z – 2)**" is introduced to approximate the quantity of activity coefficient **A**, as well as consider the attendance (which will reduce non-attendance). This component is introduced to exclude the awarding of a careless student who does not have any positive points a t all (when **PO** = 0, power expression raises to 1, i.e. "inactivity" of the negligent student raises his module estimation to 1, which is not fair). In order to increase/decrease the number of points for activity (at the absence of course work) one can introduce an extra gravimetric coefficient at **PO** or **ZS**. The number of points for the final module test can be increased/decreased so that the total module assessment equaled to 50 (or some other set criterion).

Consequently, unlike our previous work [3] this one suggests not to limit the number of points for activity too rigidly (eg. only 10, which can be quite an arbitrary and not always a logical choice) but combine the result of student's work with his diligence more closely and flexibly. This can help to enhance the efficiency of the educational activity of the student (more work provides with a more positive estimation and hence more points, less non-attendances, and finally, more information). It is a classic example of positive feedback between the components of the system, when it is required to get a maximum return (result). If it is necessary the performance during practical lessons will be taken into account considerably. (Similarly the laboratory work might play significant role in the final assessment of the module. This will depend upon specific educational institution or subject studied.)

Thus, final formula for a general module assessment of student performance looks like:

$$\mathbf{mod} = \mathbf{ave}_{\mathbf{prac}} + \mathbf{ave}_{\mathbf{lab}} + \mathbf{MCW} + (\mathbf{PO} + \mathbf{ZS})^{\mathbf{PO}/(\mathbf{Z}-1)}[\mathbf{PO}/(\mathbf{Z}-1)]^{1/\mathbf{ZS}} \qquad (2)$$

wherein **ave** – is an average estimation of student's activity at practical and laboratory classes; **MCW** – assessment of the final module test; '**PO**' – the number of positive estimations; **ZS** – the number of classes attended by the student. The last component of the formula includes the general assessment of the student performance at the lessons during the module period.

The given formula was applied postfactum for the assessment of the progress of students of the Lviv State University of Vital Activity Safety of the second year of study during the third module of the course "The Theory of Development and Ceasing of Burning" which exemplifies multiform discipline. Its former title was "Special Chemistry".

The given course represents both lectures and a difficult complex of practical and laboratory classes. Practical classes require the knowledge of chemistry, physics, thermodynamics and heating engineering, as well as the ability to apply this knowledge with the help of calculable mathematics and computer literacy. The laboratory work includes the subjects (e.g. "Determination of the Speed of Flame Distribution on the Surface of Hard-Combustible Materials", "Determination of the Temperature of Flash" etc.) where students should additionally demonstrate the skills of the experi-

mental work, knowledge of instrument technology and devices, ability to analyze the results and make conclusions as well as take initiative and demonstrate activity rather then mere passive contemplation and fixation of the given results. The course work also requires the knowledge and skill to work with the manuals, reference books, Internet.

While analyzing those quite difficult forms of classes, one can picture an indirect and psychological portrait of the student, define either commanding or dependent inclinations and skills, estimate his executiveness, carefulness, accuracy which is very important for the work of fireman and rescuer.

The obtained results of calculations (table 1) showed a good coincidence of the additional quantity for the activity with the number of positive estimations given to the student while conducting the classes. The correlation of active and successful work of the student as well as quantity of points for such activity is very well perceived during education process (the number of positive estimations while performing practical and laboratory tasks).

Table 1

Assessment results of students' progress

Student	Points for the 3rd module received in usual way (without **A**)	Quantity of the coefficient of activity **A** (parenthesis include the general number of positive estimations)	Quantity of the coefficient of activity **A** (parenthesis include the number of positive estimations for laboratory work)	Quantity of the coefficient of activity **A** (parenthesis include the number of positive estimations for practical classes)
Stud 1	37	4.42 (5)	2.06 (3)	1.42 (2)
Stud 2	15	2.17 (3)	2.17 (3)	0 (0)
Stud 3	31	11.15 (7)	3.34 (4)	2.28 (3)
Stud 4	16	3.34 (4)	3.34 (4)	0 (0)
Stud 5	27	7.38 (6)	3.34 (4)	1.56 (2)
Stud 6	27	2.17 (3)	2.17 (3)	0 (0)
Stud 7	42	11.15 (7)	3.34 (4)	2.28 (3)
Stud 8	21	2.28 (3)	1.56 (2)	1.06 (1)
Stud 10	27	3.18 (4)	2.17 (3)	1.01 (1)
Stud 11	9	1.49 (2)	1.49 (2)	0 (0)
Stud 14	17	1.49 (2)	1.49 (2)	0 (0)
Stud 16	20	7.38 (6)	3.34 (4)	1.56 (2)
Stud 17	28	2.17 (3)	2.17 (3)	0 (0)
Stud 19	28	3.34 (4)	3.34 (4)	0 (0)
Stud 20	26	3.34 (4)	3.34 (4)	0 (0)
Stud 22	24	4.68 (5)	3.18 (5)	1.01 (1)
Stud 24	25	4.94 (5)	2.28 (3)	1.56 (2)
Stud 25	2	1.49 (2)	1.49 (2)	0 (0)
Stud 26	35	7.38 (6)	3.34 (4)	1.56 (2)
Stud 29	9	1.49 (2)	1.49 (2)	0 (0)
Stud 30	43	17.00 (8)	3.34 (4)	3.34 (4)

For example, performance assessment (for Student 1) can be calculated in the following way: general number of classes "**Z**" during the module period constitutes 9 (**Z** = 9); non-attendances due to illness equal 2, consequently the number of attended classes equals to 7 (**ZS** = **Z** – 2 = 7); the general number of positive marks (4, 4, 4, 5, 5) equals 5 (**PO** = 5); and furthermore the average mark for practical tasks equals ave_{pr} = (4+4)/2 = 4.0. The number of laboratory classes constitutes 4, average mark for laboratory work equals (4+5+5+0)/4 = 3.5. The general performance score of Student 1 constitutes 4.41 (for general number **PO** = 5). The score of the module test equals to 30 points. One can easily perceive that the suggested formula (2) is rather simple and provides evident quantity results, demonstrates weak points of the student's education process which must be strengthened and demonstrates the ways of removing drawbacks.

The above-mentioned formula is rather universal and flexible since it is possible to change any of its components in case of need, i.e. to change the quantity of activity or estimation of the module test, to count the average points for practical and laboratory tasks together or separately, to introduce additional points for completion of difficult technical (laboratory), individual tasks, essays etc. The modification of the formula for consideration of specificities of a certain discipline does not represent any difficulties either.

The formula also allows to calculate the number of module points for the student right after the conducting of the first lesson and subsequently (using e.g. Excel) to introduce the current account of points till module termination, i.e. to take control over the learning process in the group of students.

It is also important that the quantity of activity **A** can serve as an independent and objective criterion to evaluate the characteristics of the student.

The additional pedagogical reasoning to use the formula in order to calculate the points is the fact that due to their prior acquaintance with the methodology of assessment students receive the actual picture about the possible ways of raising their estimations which will stimulate the desire to study better, will strengthen the motivation and competition among students.

Independent and stable state budget financing of education is also a necessary component of objective progress evaluation. Otherwise the teacher may face a dilemma: he should either pursue objective and accurate progress evaluation and quality training of the students inevitably resulting in competition, tough selection and slowly progressing student drop out (notwithstanding this, lowering of the actual teacher workload causes reduction of the study hours and financing) or reduce the requirements for education assessment which leads to lowering its objectivity and independence.

Thus, the use of such formula for the assessment of diligence of the student during his studying along with other stimuli will contribute to the increase of the level of preparation of the student. Such method of progress assessment can also be applied for the determination of the general module assessment during the study of fundamental disciplines (chemistry, physics and mathematics). This method of module assessment is supposed to be useful, possibly with some improvements and remarks, in the higher educational institutions of other, not necessarily technical profile as well as in the work of personnel of emergency and rescue subdivisions of the Ministry of Emergency Measures, which require constant learning, retraining and perfection of the knowledge and skills.

Besides, the quality of students' performance should be assessed very objectively and carefully to avoid the situation when the computer calculating a necessary score decides a fate of a student at a crucial moment.

The given method of considering student' performance during the process of education can be applied in other systems of education with slight modifications.

More flexible system of module assessment should be developed i.e. it might be possible to accept variable ultimate module score. Undoubtedly the specificity of the subjects should be taken into account i.e. either fundamental, humanitarian or technical since the number of laboratory or practical tasks can be different in them.

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В.В. Ощаповський, В.В. Шило

УРАХУВАННЯ АКАДЕМІЧНОЇ АКТИВНОСТІ СТУДЕНТА ПРИ ОЦІНЮВАННІ ЙОГО ЗНАНЬ

Розглянута ситуація з критеріальним оцінюванням учбового модуля при підготовці спеціалістів у відповідності із Болонскою системою освіти і використанням модульної системи. Запропонована нова універсальна формула для оцінювання якості підготовки,

$$\text{mod} = \text{ave}_{\text{prac}} + \text{ave}_{\text{lab}} + \text{MCW} + (\text{PO} + \text{ZS})^{\text{PO}/(\text{Z}-1)}[\text{PO}/(\text{Z}-1)]^{1/\text{ZS}},$$

яка враховує як особливості навчальної дисципліни, так і оволодіння нею слухчами, що дозволить підвищити ефективність навчання студентів (курсантів), у т.ч. тих, що навчаються в підрозділах МНС України.

Ключові слова: Болонська система; студентська активність; оцінювання.

В.В. Ощаповский, В.В. Шило

УЧЕТ АКАДЕМИЧЕСКОЙ АКТИВНОСТИ СТУДЕНТА ПРИ ОЦЕНИВАНИИ ЕГО ЗНАНИЙ

Рассмотрена ситуация с критериальным оцениванием учебного модуля при подготовке специалистов в соответствии с Болонской системой образования и использованием модульной системы. Предложена новая универсальная формула для оценивания качества подготовки

$$\text{mod} = \text{ave}_{\text{prac}} + \text{ave}_{\text{lab}} + \text{MCW} + (\text{PO} + \text{ZS})^{\text{PO}/(\text{Z}-1)}[\text{PO}/(\text{Z}-1)]^{1/\text{ZS}},$$

учитывающая как особенности учебной дисциплины, так и овладевание ею учащимися, что позволит повысить эффективность обучения студентов (курсантов), в т.ч. обучающихся в подразделениях МЧС Украины.

Ключевые слова: Болонская система; студенческая активность; оценивание.

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