



Chemical Circle as a Basis for Improving the Knowledge and Practical Skills in the Discipline “Analytical Chemistry”

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Abstract

Conducted calculations of progress of students of II course of the Faculty of bakery and confectionery industries for 2012 - 2014 years. Shown causes affecting the academic performance of students and the quality of their work in groups. Done a comparison of academic performance of student of academic groups and members of the chemical circle "Nanocolorant". We recommend increasing of hours to improve learning and development skills on the subject "Analytical chemistry" for students of technological specialties.

Practical applications

The results of the calculations can offer advice and methods to improve the teaching of the discipline "Analytical chemistry" and the program of regulatory discipline for bachelors direction "Food technology and engineering."

Key words: chemical circle, analytical chemistry, quality and performance training



Introduction

One of the main tasks entrusted to the head of the chemical circle – is to help the student in-depth study of the subject "Analytical chemistry". For students of the specialty "Food Technology and Engineering" course on the subject "Analytical chemistry" consists of 16 hours of lectures, which are read only in the first semester, 56 hours of laboratory exercises in the first and second semester and 108 hours of independent work.

Unfortunately, eight lectures scheduled on the program of regulatory discipline and the work program of regulatory discipline, is not sufficient for a full and meaningful study of discipline. Full details of the material must include both qualitative and quantitative methods for the analysis of food products and raw materials [1, 2].

Materials and methods

One of the methods of scientific work with students in the higher educational institution's teacher chemist is chemistry group [1–3]. It includes students who wish to improve their theoretical knowledge and practical skills to work in a chemical laboratory for in-depth study of the discipline "Analytical chemistry". The number of students does not exceed 6 – 8 people, which increased during individual work with each student individually. For a more voluminous chemical experiment, for example, when determining the content of nitrate ions in food products, 10-15 students worked in the laboratory to conduct preparatory operations preparation of products: cleaning, cutting and grinding. This approach has allowed the students to learn how to do all kinds of preparatory process, as well as prepare standard samples of nitrate ions, to measure the potential of nitrate ions in a solution prepared food samples.

The work of students in chemical group was held after the main lessons in extra time to give students an opportunity to focus on preparing for the direct implementation and conduct chemical experiments. Each Student of group performs the work by themselves under the individual control of teacher. This method and form of control of the student by teacher will significantly increase the time and opportunity to teach students to conduct independent chemical experiments and to improve students' practical skills when working with chemical equipment and devices.

In studying the topic "The method of neutralization," "Redox method," and "Deposition method and complexation" used individual work with each student to teach him by a technic of titration of solutions, for different types of reactions. Only the method of individual approach to the student has given the opportunity to teaching each of them titration technique: proper preparation burette to work, which includes two major stages – is filling the burette titrant solution and removal of air bubbles in the system. As a result, the overall work of the teacher and the student was able to increase the accuracy of the titration, which allowed us to obtain reproducible results in the calculation formulas.

Results

According to the results of examinations carried out an analysis of student performance groups TB–II–1–3 specialty "Food Technology" specialization "Technology of bread, pastry, pasta and food concentrates" (TB–II–1,2), and "Storage and Processing Technologies grain" (TG–II–3), and students engaged in chemical group "Nanocolorant". Overall academic performance of students of the second year of the Faculty of Technology of bakery and confectionery industries (TBG) for the 2012 –2013 academic year is presented in Table 1, for the 2013 –2014 academic year – in Table 2 [4–7].

Tables 1 and 2 show the overall performance of students from II course Faculty of TBG 2012 – 2013 and 2013–2014 academic years in the specialty "Food Technology" specialization "Technology of bread, pastry, pasta and food concentrates" (TB–II–1,2), and "Grain storage and processing technologies" (TG–II–3). The total number of students who studied during the I semester (autumn 2012 and 2013) and II semester (spring 2013 and 2014) was 65/63 and 61/60, respectively. In each group the average number was about 20 people, among them students who wish to improve their knowledge and skills within the chemical circle "Nanocolorant". Classes are conducted in the chemical laboratory in the presence of a teacher and a laboratory assistant in the overtime. The total number of members of the circle was 23 and 28, which corresponds to 35/37 and 46/47% relative to the total number of students in faculty.



Table 1. Total student performance course II group TBG-II-1,2,3
Faculty of Technology of bakery and confectionery production for the 2012-2013 academic year

The autumn 2012/spring 2013	Group TB-II-1	Progress Students of the group, %	Group TB-II-2	Progress Students of the group, %	Group TG-II-3	Progress Students of the group, %	The total amount of students:
The number of students in the group	22/22	100/100	21/19	100/100	22/22	100/100	65/63
Progress Students of the group: 5	0/3	0/14	0/2	0/11	1/7	5/32	1/12
4	10/13	45/59	8/15	38/79	9/13	41/59	27/41
3	12/5	55/23	11/2	52/11	10/2	45/9	33/9
2	0		2/0		0/0		2/0
Number of members of the chemical circle "Nanocolorant"	9/9		5/5		9/9		23/23
% of group	41/41		24/26		41/41		35/37
% of faculty	13,8/14,3		7,7/7,9		13,8/14,3		11,8/12,2

Table 2. Total student performance course II group TBG-II-1,2,3
Faculty of Technology of bakery and confectionery production for the 2013-2014 academic year

The autumn 2013/spring 2014	Group TB-II-1	Progress Students of the group, %	Group TB-II-2	Progress Students of the group, %	Group TG-II-3	Progress Students of the group, %	The total amount of students:
The number of students in the group	22/21	100/100	21/21	100/100	19/18	100/100	61/60
Progress Students of the group: 5	4/5	18/24	8/5	38/24	1/0	6/0	13/10
4	7/6	32/29	11/9	52/43	7/7	39/39	25/22
3	8/9	36/43	2/6	10/29	9/10	50/56	19/25
2	3/1	14/5	0/1	0/5	2/1	11/6	3/3
The number of positive estimates	19/20	86/95	21/20	100/95	17/18	89/89	
Number of members of the chemical circle "Nanocolorant"	9/9		12/12		7/7		28/28
% of group	41/43		57/57		39/39		46/47
% of faculty	14,8/15		19,7/20		11,5/11,7		15,3/15,6



Discussion

Performance analysis of members of the group showed that in the second semester the number of students who received "excellent" and "good" from 1 to 12 and 27 to 41 has increased, respectively. This suggests that employment in the chemical circle for the 2012 – 2013 academic year tested positive and will allow students to learn and improve their knowledge and practical skills in the study of the discipline "Analytical chemistry". In 2013 – 2014 year compared to the 2012 – 2013 academic year, the number of successful students increased to 13/10 and 25/22 of students, and this is independent of the semester. All students who have received the highest scores on the results of the differential credit are members of a chemical circle. The best among the groups for the 2012 – 2013 were the group of TB-II-1 and TG-II-3, which was engaged to 9 students in the circle that was 41% of the group and 13,8 / 14,3% of the faculty. In 2013 – 2014 the best of groups of faculty TBG were TB-II-2 and TB-II-1. Those had of 12 and 9 members of the circle accordingly that draw up 57/57 and 41/43% - of students the group and 19,7 /

20 and 14,8/15% - of students by faculty. Analysis of the overall performance of students TBG faculty showed that additional workshops within the chemical circle "Nanocolorant" allowed to significantly increase the students' progress, to acquire and improve their skills by using the chemical glassware and instruments, techniques of titration of dilute solutions, technology, weighing on an analytical balance and subsequently preparing standard solutions. As in the study of the course of discipline "Analytical chemistry" program does not provide practical training where possible to study the solution of practical problems in the discipline, this omission could compensate by training students in chemical circle. The method of individual approach to every student group allowed the teacher to explain and teach solving complex chemical problems. In the future, it will enable students to carry out their own calculations and calculations on the results of their same chemical experiments.

General information about the members of the circle of the chemical is shown in Tables 3 and 4.

Table 3. General information about students of chemical circle "Nanocolorant" faculty of TBG for 2012–2013 academic year

the autumn 2012/spring 2013	Number of members of the chemical group "Nanocolorant"	Progress members of the chemical group			
		5	4	3	2
Number of members of the circle in the group TB-II-1:	9/9	0/3	6/6	3/0	–
Progress among the members the circle in the group TB-II-1, %	41/41	0/14	27/27	14/0	–
Progress the members of circle in the group TB-II-1, %	100/100	0/33	67/67	33/0	–
Number of members of the circle in the group TB-II-2:	5/5	0/2	4/3	1/0	–
Progress among the members the circle (група TB-II-2), %	24/26	0/11	19/16	5/0	–
Progress the members of circle in the group TB-II-2, %	100/100	0/40	80/60	20/0	–
Number of members of the circle in the group TG-II-3:	9/9	3/5	5/4	1/0	–
Progress among the members the circle in the group TG-II-3:	41/41	14/23	23/18	5/0	–
Progress the members of circle in the group TG-II-3, %	100/100	33/56	56/44	11/0	–
	23/2335/37%	3/10	15/13	5/0	



Table 4. General information about students of chemical group "Nanocolorant" faculty of TBG for 2013–2014 academic year

the autumn 2013/spring 2014	Number of members of the chemical group "Nanocolorant"	Progress members of the chemical group:			
		5	4	3	2
Number of members of the circle in the group TB–II–1:	9/9	4/5	3/1	2/3	–
Progress among the members the circle in the group TB–II–1, %	41/41	18/24	14/5	9/14	–
Progress the members of circle in the group TB–II–1, %	100/100	44/56	33/11	22/33	–
Number of members of the circle in the group TB–II–2:	12/12	7/5	5/6	0/1	–
Progress among the members the circle in the group TB–II–2, %	57/57	33/24	24/29	0/5	–
Progress the members of circle in the group TB–II–2, %	100/100	58/42	42/50	0/8	–
Number of members of the circle in the group TG–II–3:	7/7	1/0	6/5	0/2	–
Progress among the members the circle in the group TG–II–3:	39/39	6/0	33/28	0/11	–
Progress the members of circle in the group TG–II–3, %	100/100	14/0	86/71	0/29	–
	28/28 46/47%	12/10	14/12	2/6	

As shown in Table 3 and 4, the number of students of the Faculty of TBG, who were participating in chemical circle, for 2012 –2013 and 2013 – 2014 school year was 23 and 28 members, respectively. With respect to the total students of this corresponds to 11,8 / 12,2% in group and 15,3 / 15,6% in faculty. The quantity of students of circle does not depend on the group. So in the 2012 – 2013 academic year, the maximum number of students engaged in the circle was 9, the group TB–II–1, TG–II–3. In the next academic 2013 – 2014, their number increased to 12 in the group TB–II–2, which constituted 57% of the total number of students in the group, and 19,7 / 20% of the total number of students of the Faculty. The number of students who received excellent evaluation were 0/3, 0/2 and 3/5 of the student, which amounted to 33, 40 and 56% in groups, and the assessment of the well-received 6/6, 4/3 and 5/4 of the student that make up 67/67, 80/60 and 56/44% of the total number of students in the group.

Compared to the 2012 – 2013 academic year in 2013 – 2014 saw an increasing number of members of the group for 5 persons from 23 to 28, which accounted for 37 and 47%, respectively. Also, it

increased the number of students who were rated excellent with 3 to 12 which corresponds to the 5 and 16%. Assessment is well received 15/13 and 14/12 that make up the 23/21 and 23/20% of students. The best group of the 2013 – 2014 year there was a group of TB–II–2.

That good result has allowed the students to better learn and understand all the topics of the course discipline "Analytical chemistry", to improve their practical skills and to work in a chemical laboratory.

After processing of the experimental results the circle members have issued research reports and presentations with used PowerPoint program and were presented at the scientific seminar of the department and the annual International scientific-practical conference of young scientists and students, which takes place at the university.

On this conference also have been published abstracts of experimental studies of members of circle "Nanocolorant".

The final stage after studying sections of the course Analytical Chemistry is differential credit, which was carried out in June and consisted of two parts: theoretical and experimental. The first part included



the answers to theoretical questions, and the second - the practical part of the chemical experiment, for one of topics proposed by the teacher. This differential approach allowed to making up a more accurate assessment of the knowledge and practical skills of students. As most of students are members of the group "Nanocolorant" they have been prepared more thoroughly in theoretical matters, and in carrying out a chemical experiment. They also quickly and efficiently performed the tasks, had good orientation in the laboratory, that will allow in the future to carry out qualitatively experiment properly perform calculations and draw graphs, draw conclusions about the work which is done. Also, these skills will allow students to carry out a quality course and diploma projects for the protection of the Bachelor and Master's thesis.

Conclusions

1. Additional lessons with students of the second year of the Faculty of TBG on the discipline "Analytical chemistry" within the chemical circle "Nanocolorant" were shown increasing of student performance of members of the circle in the 2013 - 2014 school year, compared to members of the circle in the 2012 - 2013 school year.
2. Systematic lessons with members of the circle will improve their skills when working with chemicals and equipment.
3. By results of the examination session analyzed the progress of students in academic groups of faculty and of members of the circle. Was shown better result progress of students of a chemical circle than students of a group.
4. For the better study of the discipline "Analytical chemistry", it is possible to recommend an increase

in the number of hours for lectures, laboratory lessons and practical lessons.

5. For the future experts in "Food technology" we can recommend participate in the scientific chemical circle "Nanocolorant" for the study new materials, for in-depth of theoretical knowledge and practical skills, to further their use in performing course projects and activities, as well as when working in chemical laboratories and laboratories of food industry .

References

- The Law of Ukraine About higher education Verkhovna Rada of Ukraine; Law of 01.07.2014 number 1556–VII (1556–18 document, chinny, precisely redaksion– of acceptance of 01.07.2014) <http://zakon4.rada.gov.ua/laws/show/1556–18/page>
- The Law of Ukraine About Science and sciences-technical Verkhovna Rada of Ukraine; Law of 13.12.1991 number 1977–XII (1977–12 document, chinny, precisely redaksia–Redaksion of 09.06.2014, base 1556–18) <http://zakon4.rada.gov.ua/laws/show/1977–12 / page>
- Normative documents of NUFT. The provisions about sciences–experimental work of students <http://nuft.edu.ua/page/view/polozhennya-pro-naukovodoslidnu-robotu-studentiv>.
- Statement of academician students of the TBG group TB–II–1 of the III, IV semester.
- Statement of academician students of the TBG group TB–II–2 for III, IV semester.
- Statement of the Faculty students' progress TBG group TG–II–3 for the III, IV semester.