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COMPARATIVE CORRELATION CHARACTERISTICS BETWEEN ORGANIC AND BIOORGANIC CHEMISTRY STUDIES OF PHARMACEUTICAL AND MEDICAL FACULTIES' STUDENTS DURING 2014-2015 YEAR'S FALL SEMESTER

A correlation research of some organic and bioorganic chemistry study parameters of Zaporizhzhya State Medical University students of "Pharmacy" and "Medicine" faculties during 2014-2015 year fall semester was conducted, namely, between the preparation time for the theoretical part and tests solving, influence of school education to the subject learning and to all disciplines in university, with the aim to improve the quality of education.

***Keywords: organic** and bioorganic chemistry, university education, Pearson product moment correlation, Spearman rank correlation, Kolmogorov-Smirnov comparison.*

Було проведено дослідження взаємозв'язку між деякими параметрами при вивченні органічної та біоорганічної хімії студентів Запорізького державного медичного університету напряму «Фармація» та «Медицина» осіннього семестру 2014-2015 року, а саме, між часом підготовки до теоретичної частини заняття, до тестування, впливом шкільної підготовки на вивчення предмету у ВНЗ та взагалі всіх дисциплін, з метою поліпшення якості освіти.

***Ключеві слова:** біоорганічна хімія, вища освіта, кореляція Пірсона, рангова кореляція Спірмена, тест Колмогорова-Смирнова.*

Было проведено исследование взаимосвязи между некоторыми параметрами при изучении органической и биоорганической химии студентов Запорожского государственного медицинского университета направления «Фармация» и «Медицина» осеннего семестра 2014-2015 года, а именно, между временем подготовки к теоретической части занятия, к тестированию, влиянием школьной подготовки на изучение предмета в ВУЗе и в целом всех дисциплин, с целью улучшения качества образования.

Ключевые слова: *биоорганическая химия, высшее образование, корреляция Пирсона, ранговая корреляция Спирмена, тест Колмогорова-Смирнова.*

Introduction

Bioorganic chemistry is studied according to the approved model program in 2014 for III-IV accreditation levels universities for specialty 7.110101 "Medicine", in accordance with the educational qualification characteristics and professional training programs approved by Ukraine Ministry of Health Order № 239 from 16.04.2003. The curriculum of specialty "General Medicine" is approved by the Order of Ukraine Ministry of Health № 504 from 28.07.03. It consists of 60 hours, including lectures, practical lessons and submodules.

Organic chemistry is studied according to the program of 2014 year for the same level of accreditation for specialty 1202 "Pharmacy", in accordance with characteristics approved by Ukraine Ministry of Health Order № 930 from 07.12.09 and № 542 from 08.07.10. The schedule consists of 324 hours, including lectures, practical lessons, submodules and final modules.

The traditional course of subject has been a fixture for almost 20 years. The program could be divided into the 3 main parts: 1) theoretical basis of the structure of organic compounds; 2) heterofunctional organic compounds, metabolites, and precursors of the most important groups of drugs, their properties and reactivity; 3) biologically important classes of bioorganic compounds, biopolymers and their structural components.

Not much has changed in the pedagogy over this time either. There are lots of ways with the purpose of improving the student's subject comprehending. The particularly important part of the lesson is communication. Some examples of the different types of speech and its impact at the students study are given in the next table (Table 1).

And that is the only part of the educational process that is done by the teachers to motivate and help students during classes. Nevertheless, the last years' quality progress of students' knowledge is reducing. This applies to students of both specialties with the greater extent of pharmaceutical one. The absence of the state budgetary form of education shows its negative role.

Thus, it was decided to compare Pharmacy and Medical Faculty students' results in their study of the subject by the means of mathematic correlation.

Materials and methods

Full-time 88 students of specialty "Pharmacy" from Pharmacy Faculty and 65 of specialty "Medicine" from

Table 1. Types of teacher's impact to improve learning of the subject.

Type of action	Definition
Inquire into	Find out prior knowledge of the subject.
Evoke	Enunciate knowledge that must be known by students.
Inform	Develop a content area affirming, describing and/or narrating.
Elaborate	Present additional information with regard to previously said by the teacher or a student.
Synthesize	Summarize the presented information during all classes.
Repeat	Reiterate what was said or done by a teacher.
Give examples	Illustrate everything with reactions examples, experiments, video films etc.
Argue	Conclude from data through justifications from scientific knowledge
Reformulate	Support the formulation in a statement of a student but introducing changes that shifting the meaning.
Compare	Examine or analyze two or more objects to discover their differences or similarities.
Answer	Reply to the students' questions.
Anticipate	Announce what will be done in class, either immediate or after class time.
Guide	Orient the direction of thought.
Evaluate	Develop student's learning and deducting abilities.
Corroborate	Check whether students understand or comprehend what was said.
Attract attention	Theatrically explain and give some stressful tasks to spark students' interest.
Order	Tell the student to do experiments.
Ask	Request information not known or that could not be heard well.
Advise	Recommend something beneficial to deepen the knowledge.
Qualify	Assigning a value to what was said by the students.

Medical Faculty were interviewed on the following issues:

1. What is the average time student spent for preparation for the computer test in minutes?

2. What is student's average test result in percentage?

3. What is the average time student spent for preparation for the theoretical material in minutes?

4. What is student's average organic/ bioorganic chemistry mark?

5. What is student's organic chemistry mark in school certificate?

6. What is student's average attestation mark for all studied subjects at the moment?

Then correlation study of two

temporal series of data was performed in order to identify positive or negative relation between them.

The most common measure of correlation in statistics is the Pearson product moment correlation or PPMC [1]. This test is used to measure the strength of a linear association between two variables, where the value r = 1 means a perfect positive correlation and the value r = -1 means a perfect negative correlation, measured by the next formula, and calculated using Excel 2007 correlation analysis tool [2].

$$r = \frac{N \sum (X - M_X) * (Y - M_Y)}{\sqrt{(\sum (X - M_X)^2 * \sum (Y - M_Y)^2)}}$$

At the next step, the data were checked for the type of distribution: whether it follows a normal distribution or not (in the first case parametric test is used and in the second case - a non-parametric). Easy and quick Kolmogorov-Smirnov comparison of two data sets was applied in this case [3]. The online calculations showed that it is a non-parametric distribution [4].

So, Pearson is a parametric one, and due to the fact, that variables are not normally distributed and the relationship between the variables is not very linear, it is more appropriate to use the Spearman rank correlation method.

Spearman rank correlation is a non-parametric test that assesses how good the relationship between two variables could be described using a monotonic function and is it flexible enough [5]. Spearman test also could be used instead of linear regression/correlation for two measurement variables if there are some worries about non-normality:

$$r_s = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$

The value of the coefficient of 0.3 or less is considered as the weak performance correlation; values greater than 0.4 but less than 0.7 is a moderate one, and values of 0.7 or more is an indicator of high closeness between parameters. Online electronic calculator was used to calculate r_s [6].

Results and discussion

In the result of the calculations the following Pearson correlation values were obtained for both faculties (Table 2, 3).

Interesting fact was observed in the Pharmacy student's data: negative correlation between preparation time for tests and their results (Table 2). It is known, that student needs to understand the reason for choosing the right answer, but not to memorize a set of letters and formulas for successful completion of testing. But sometimes the more time they are giving to this task – the more they get confused. School basic knowledge is just a little bit of help - it shortens the time of students' preparation as well as theory background. At the same level appears to be the knowledge of other university subjects, which also slightly affected the ability of this subject evaluation.

Considering the tests results the maximum positive influence had university mark. The better student studied theory – the better he solved the problems. Preparation time for theory was greatly influenced by school certificate organic chemistry mark. It has the best correlation among all investigated parameters. University organic chemistry and average attestation marks were in positive dependence too. School mark affirmatively had affected the organic chemistry grade, but not a lot. As well as student educational level,

Table 2. Pearson Product Moment Correlation for Pharmacy students' data.

Parameters	Tests prepar. time	Tests results	Theor. prepar. time	Org./ bioorg chem. mark	School org. chem. mark	Univ. attest. mark
Tests prepar. time	1					
Tests results	-0.24726	1				
Theory prepar. time	0.17971	0.10851	1			
Org./bioorg chem. mark	-0.2107	0.13243	0.25290	1		
School org. chem. mark	-0.0607	-0.0350	0.45044	0.20760	1	
Univ. attest. mark	-0.0525	0.04222	0.12732	0.23016	0.35055	1

taking into account the average rating in all subjects, that correlated with school certificate results.

The consequent analysis of the Medicine students' data had shown the opposite correlation between the school certificate organic chemistry mark; preparation time for theory and all subjects' average mark (Table 3).

Preparation time for tests practically hadn't influenced its result. Theory base had a little positive impact, but more than

Table 3. Pearson Product Moment Correlation for Medicine students' data.

Parameters	Tests prepar. time	Tests results	Theor. prepar. time	Org./ bioorg chem. mark	School org. chem. mark	Univ. attest. mark
Tests prepar. time	1					
Tests results	0.00635	1				
Theory prepar. time	0.11330	0.23982	1			
Org./bioorg chem. mark	-0.03059	0.46936	0.29128	1		
School org. chem. mark	0.04537	0.09757	0.06988	0.32355	1	
Univ. attest. mark	-0.08836	0.02722	0.05967	0.29570	0.02423	1

Table 4. Spearmen correlations results.

Pharmacy students' data		Medical students' data		
Prep. time for theory / school org. chem. mark	Prep. time for tests / tests results	Prep. time for theory / tests results	Univ. bioorg. chem. mark / school org. chem. mark	Univ. attest. mark / school org. chem. mark
Spearmen correlation coefficient				
0.343117366	-0.26057903	0.277923240	0.243050598	0.327565641
T_f , recalculation coefficient for critical values of Student t-test				
3.38759164	2.50298226	2.2964187	1.98879098	2.75179239
Critical values from the table of Student t-test: $t_{cr} = 1.964$ for $P \leq 0.05$ $t_{cr} = 2.785$ for $P < 0.01$				
The correlation is statistically significant at the level of				
all	0.05			

a school mark. University experience shortened the time for homework.

The test results were influenced a lot by university bioorganic chemistry mark with the best correlation coefficient, than goes preparation time for theory. And at the last place are school and average attestation marks.

The better medical student studied – the more time he spent for theory preparation. Marks also had a light positive impact in this case.

School certificate and all university average grades were in a good correlation. So, we could see the result of the state budgetary form of education presence in this faculty. In spite of this fact, bioorganic chemistry seems too hard for students, because influence at the subject mark was very low.

After completing Pearson screening, according to Kolmogorov-Smirnov comparison of each two data sets, it was found, that investigated data distribution was a non-parametric one [4]. So, flexible Spearman rank correlation was carried out (Table 4) [6].

The relation between preparation time for theory and school certificate organic chemistry mark of pharmaceutical students was completely statistically significant (Table 4). And only four correlations were found to be statistically significant at the level of 0.05: 1 for Pharmacy students and 3 for Medicine ones.

Hence, pharmaceutical faculty students' tests preparation time and their results were in a negative correlation. And, it's true, according to the computers files, which very often indicated the lower students' tests results with each next attempt, especially for slackers. Level of school education had a significant impact on the learning process at the university.

Speaking about medical students, the considerable impact also was made by school level of organic chemistry to average university mark. School subjects' theoretical bases as well as university

bioorganic chemistry theory preparation and computer tests results were also in a positive correlation.

Conclusions

As a consequence of Pearson correlation, it was found, that the best positive relation for medical faculty students was between preparation time for theory and school certificate mark. Considering the pharmacy faculty: between university organic chemistry mark and tests results. It should be mentioned, that school grades had positive impact on average university marks for pharmaceutical students, but not for medical ones. It could be related with the priority of the organic chemistry in certificate when entering the university.

So, to improve university chemistry study, the entrance educational level should be increased or at least not reduced, because organic chemistry material is very important and considerable for "Pharmacy" students and readily starts upon the some basic knowledge from the first class. And "Medicine" students have to learn the basics of bioorganic chemistry only for 14 lessons, having lots of other very significant subjects.

The Spearmen rank correlation confirmed the negative influence of the time homework prolongation for the computer tests evaluation for Pharmacy faculty. Hence, teachers have to give more time for explanation during lesson, providing all the necessary representations to visualize the structures and rationalize the relativities of the substances for better problem solving. Surprisingly "Medicine" students' school level of organic chemistry and average university mark were in a good correlation, unlike to Pearson results.

Summing up, we shouldn't forget the conclusion of Hauke and Kossowski investigation: "Make sure not to over interpret Spearman's rank correlation coefficient as a significant measure of the strength of the associations between two variables". Because there much more factors influencing the successful study, namely, learning abilities, place of living, state of health, relationships in the group, various styles of teaching etc. But every student should find his own gold mean of successful education under the pressure of various factors. And only smart study would lead to outstanding future specialists.

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