

# REPORT

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Regarding the dissertation for awarding the educational and scientific degree "Doctor",  
Professional Field 1.3 Pedagogy of Teaching in (Teaching Methodology Chemistry)

Author: Kalin Nikolaev Chakarov

Topic: Difficult Topisc in the Chemistry Curriculum – Students' and Teachers' View. Learning  
Difficulties of Students in Organic Chemistry at the Basic Level

## 1. General Presentation of the Procedure and the PhD Student

The author of the dissertation is Kalin Nikolaev Chakarov – PhD student at the Department of Physical Chemistry, Faculty of Chemistry and Pharmacy, Sofia University "St. Kliment Ohridski".

The materials presented by Kalin Nikolaev Chakarov are in accordance with the Regulations for the terms and conditions for acquiring scientific degrees and holding academic positions at Sofia University "St. Kliment Ohridski", and Kalin Chakarov was admitted to defense at a meeting of the scientific jury held on 02/27/2023.

Kalin Chakarov completed his secondary education in 2010 at High School "Prof. Asen Zlatarov", Pleven. In the same year, he became a student at University of Chemical Technology and Metallurgy, Sofia, where in 2014 he graduated as a "Bachelor", speciality "Fine Organic Synthesis". In 2015 Kalin Chakarov acquired the professional qualification "Teacher of Chemistry and Environmental Protection". In 2018, he graduated with a Master's degree "Teacher of Chemistry" at the Faculty of Chemistry and Pharmacy. Since February 2019, Kalin Chakarov has been enrolled as a full-time PhD student at the Department of Physical Chemistry of the Faculty of Chemistry and Pharmacy, SU, Professional field: 1.3 Pedagogy of Teaching in (Teaching Methodology Chemistry).

From 2017 to 2021, the PhD student Chakarov worked as a Teacher of Chemistry. In 2021, he is appointed as a chemist at University of Chemical Technology and Metallurgy, Sofia, and in 2022 he became an Assistant Professor in General and Inorganic Chemistry Department of the same education institution.

## 2. Actuality and Appropriateness of the Topic

The PhD Thesis developed by Kalin Chakarov is related to the identification of difficult topics for students during their general education in Chemistry with an emphasis – the identification of the specific difficulties they encounter during their studies in Organic chemistry at the basic level. The topic of the Thesis is relevant, as the data on the students' opinion, on the specific results they have shown and on the point of view of the teachers are extremely valuable at any moment for compilers of study programs, textbook authors, educational researchers, teachers, university professors.

## 3. Familiarity with the Scientific Problem and Expediency of the Set Goals and Tasks

The comprehensive literature review made by Kalin Chakarov convinces of the relevance of the chosen topic, highlights the difficulties in teaching and learning Chemistry in secondary schools worldwide and summarizes the external and internal factors that give rise to and influence them. An analysis was made of the place of Organic chemistry in the curriculum of Chemistry and environmental protection for the 9th grade.

The features of Organic chemistry that distinguish it from other branches of Chemistry are commented on, as well as the related difficulties that could arise in the learning process. Literary

data concerning the difficulties of Organic chemistry students at a higher level of education are included and commented on.

The detailed and competent analysis of the literature has allowed the PhD to formulate research questions and to set specific tasks that are in accordance with the purpose of the PhD Thesis and guarantee its successful implementation.

#### **4. Research Methodology**

In fulfillment of the identified tasks, the PhD student conducted a research of a mixed – qualitative-quantitative type, in order to analyse in-depth the difficulties in the teaching of Chemistry, in particular – the teaching of Organic chemistry at the basic level. The chosen methods allow a clearer definition of the problems in studying and teaching Chemistry, but also outline prospects for overcoming them.

The conducted research is divided into two main stages. The first identifies the topics in the Chemistry and Environmental Protection curriculum that students find most difficult, analysing their views as well as those of their teachers. The second stage brings to the fore the problem areas in the study of Chemistry assessed as difficult in the first stage of the investigation.

#### **5. Characteristics and Evaluation of the Thesis and Contributions**

The PhD Thesis of Kalin Chakarov includes six chapters. It is written on 167 pages. It contains 50 tables, 15 figures, 6 appendices and 28 pages of references.

The conducted literature review and the PhD student's own results presented are well illustrated and competently analyzed verbally, which is an indication of achieved research maturity.

The scientific work is the first study of for Bulgaria, dedicated to the difficulties encountered by students in their studies in Organic chemistry at the basic level, as well as to the factors that determine them, according to the opinion of both students and teachers.

For the first time, the research highlights the difficult and interesting topics in Chemistry for Bulgarian secondary school students. An innovation is the identification of the areas that actually make it difficult for them to learn Organic chemistry at the basic level, as well as their subjective perceptions of difficulty and self-efficacy in the studied discipline.

The dissertation for the first time reveals the perception of the Bulgarian chemistry teachers about the students' difficulties in Organic chemistry and about their sources, as well as the teachers' views on how to effectively overcome them.

The results obtained during the development of the dissertation can serve as a starting point for future, ongoing research studies on the subject. They would be useful in the revision of old or the compilation of new Organic chemistry programmes at the basic level. They contain valuable information about writing successful textbooks in the discipline. Chemistry teachers are motivated to rethink their teaching methods, approaches and strategies in order to achieve an interesting and effective learning process, as well as the formation of lasting and useful knowledge of Organic chemistry in their students.

#### **6. Publications and Personal Contributions of the PhD Student**

The PhD Thesis leaves no doubt about personal involvement and contribution of Mr Chakarov. They are a logical continuation of his scientific activity, which began during his studies at Master's degree. The dissertation also includes results of N. Markova's Master Thesis, whose supervisor and consultant are Assoc. Prof. A. Gendjova and Kalin Chakarov, respectively. The PhD student is the author of one and co-author of three scientific publications in refereed and indexed specialized publications that reflect the results of the PhD Thesis. There are currently no data for observed citations.

Kalin Chakarov has presented the results of his research at two national scientific forums, one of which – with international participation.

## 7. PhD Thesis Abstract

The presented PhD Thesis Abstract is prepared according to the requirements, summarizes the main results of the conducted research and corresponds to the content of the dissertation.

## 8. Critical Remarks and Recommendations

I have the following remarks and recommendations:

1. In my opinion, it is not correct to include a topic entitled "Organic Chemistry: Hydrocarbons and Their Derivatives" in the first stage of the study. These are two separate topics according to the curriculum, the first of which contains 5 subtopics, and the second – four (including the most reactive studied classes of organic compounds). In practice, you expect students to compare in difficulty almost all of the studied classes of organic compounds with a topic such as "Valency and Oxidation State", for example.

2. The diagnostic test applied contains two questions – 2.7 and 5.2, to which the students can give two different answers that are correct.

3. After you indicate that the conduct of the online diagnostic test limited the "testing of procedural knowledge such as e.g. writing chemical equations", you cannot conclude that the students do not know how to express properties of studied organic substances with chemical equations.

4. Questions 7.1, 7.2 and 7.3 could assess ONLY whether students are able to extract information from the graphics. Such questions do not assess their ability to interpret it. It is often mentioned that you are expecting to receive information on both competencies.

5. Two versions of the diagnostic test are mentioned, but only one is applied to the dissertation.

6. In my opinion, the literature review of the encountered difficulties in Organic chemistry at a higher level of education is redundant.

## CONCLUSION

Kalin Chakarov's PhD Thesis contains results that represent an original contribution to science. The volume and quality of the investigation meet the generally accepted standards and correspond to all the requirements of Act for the Development of the Academic Staff in the Republic of Bulgaria (ADASRB), the Regulations for the Implementation of ADASRB, the Regulations for the Implementation of ADASRB of Sofia University.

PhD student Kalin Chakarov owns the necessary knowledge, experience and qualities to conduct scientific research independently.

Due to the above mentioned, I confidently give my positive assessment of the conducted research and the PhD Thesis, recommending the Scientific Jury to award the educational and scientific degree "Doctor" to Kalin Nikolaev Chakarov in Professional Field 1.3 Pedagogy of Teaching in (Teaching Methodology Chemistry).

Sofia

24 April 2023

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/Assoc. Prof. M. Kandinska, PhD/