LEARNING THE TOPIC OF "PHENOL AND ITS DERIVATIVES" USING MODERN CHEMICAL PROGRAMS

Murodova Sitorabonu Bahadir kizi
Bukhara State Pedagogical Institute
Lecturer of the Department of Natural Sciences
Tel: +998 (99) 700-86-07 e-mail: murodovasitorabonu98@gmail.com

Annotation: In this article, in the teaching of organic chemistry subject "Phenol and its derivatives" to students of a higher educational institution using traditional and non-traditional methods, students' mastery indicators, traditional and non-traditional methods are presented. The advantages of teaching methods are discussed. Also, the results of the analysis on the effectiveness of using chemical computer programs are mentioned. Using modern chemical computer programs ChemDraw, Chem3D and HyperChem, information on chemical compounds, their structure and properties is presented.
Keywords: ChemDraw, Chem3D, HyperChem, bond length, bond energy, empirical calculation, molecular mechanics, potential energy, minimum energy, electron affinity.

Introduction. The ChemDraw program is the most convenient chemical program when teaching chemistry in higher education institutions to have information about compounds of complex structure and, in addition, to generate the reaction equations necessary for teachers of chemistry. ChemDraw is a chemical application designed to create professional and meaningful drawings of chemical molecules and reactions. Studying the structure of compounds in chemistry with ChemDraw and Chem3D applications, which are considered very important, makes it easy to draw the structure of chemical compounds of different types, as well as to perfectly study 3D models. These programs allow orcari students to easily implement the structure of chemical compounds and various chemical computations.[1, 6]

Research methodology. When explaining the subject of organic chemistry "phenol and its derivatives" to students in higher education institutions, 2 groups were initially selected and one of them was taught in a traditional way, and the other was taught in a non-traditional way. The following sequences were performed during the non-traditional method of teaching:

1. The structural formulas of phenol and its derivatives were explained to the students, and each student was given the structural formulas of phenol and its derivatives as tasks for independent work. Students' mastery indicators were analyzed.

2. Information was provided about ChemDraw and Chem 3D chemical programs and how they work. Time was given to complete tasks given for independent work and results were
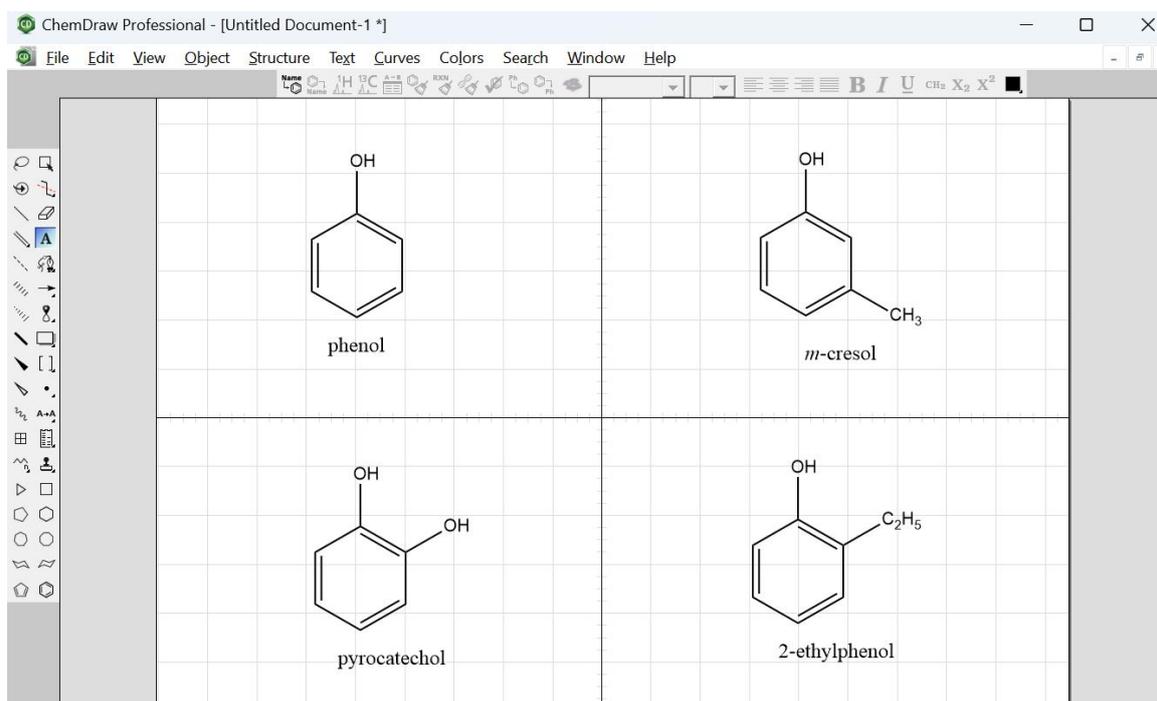
Figure 1. Writing structure formulas of phenol and its derivatives in the ChemDraw program

Modern computer programs make it possible to use mathematical methods to calculate molecular properties, model molecular behavior, plan synthesis, search databases, and process combinatorial libraries. Information and computer technologies create additional opportunities to stimulate students' creative thinking, increase the value of their independent work, control the results and simplify self-control. The expediency of using information technologies in the educational process is determined by the effective implementation of didactic principles such as the scientificity, presence, appearance, consciousness and activity of students with their help, as well as individual approach to learning.[2, 54]
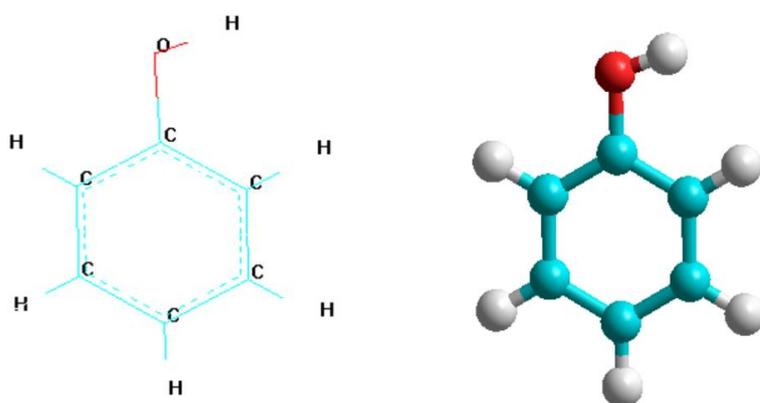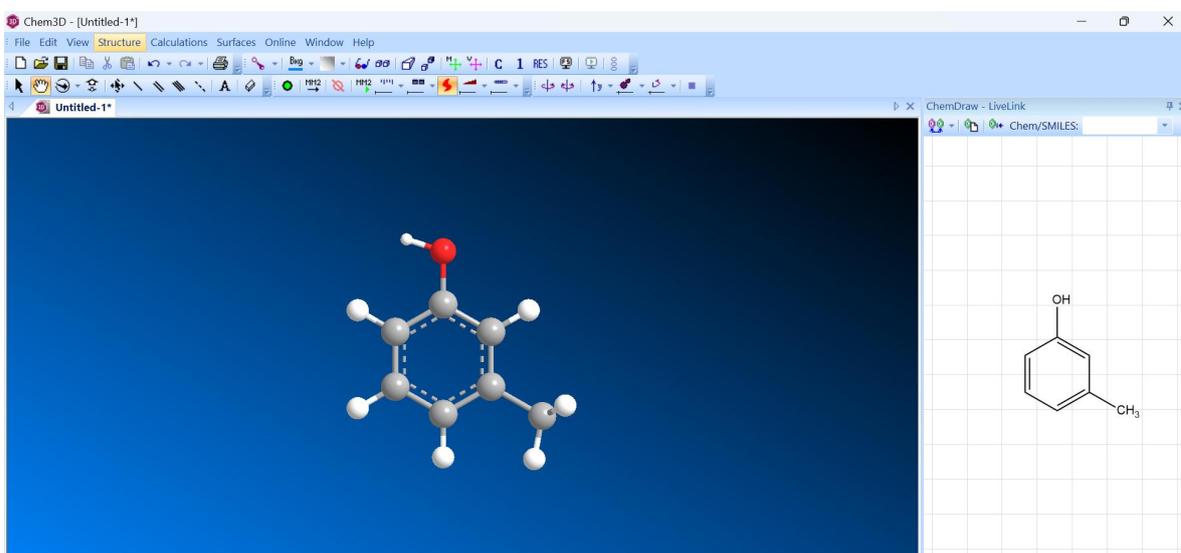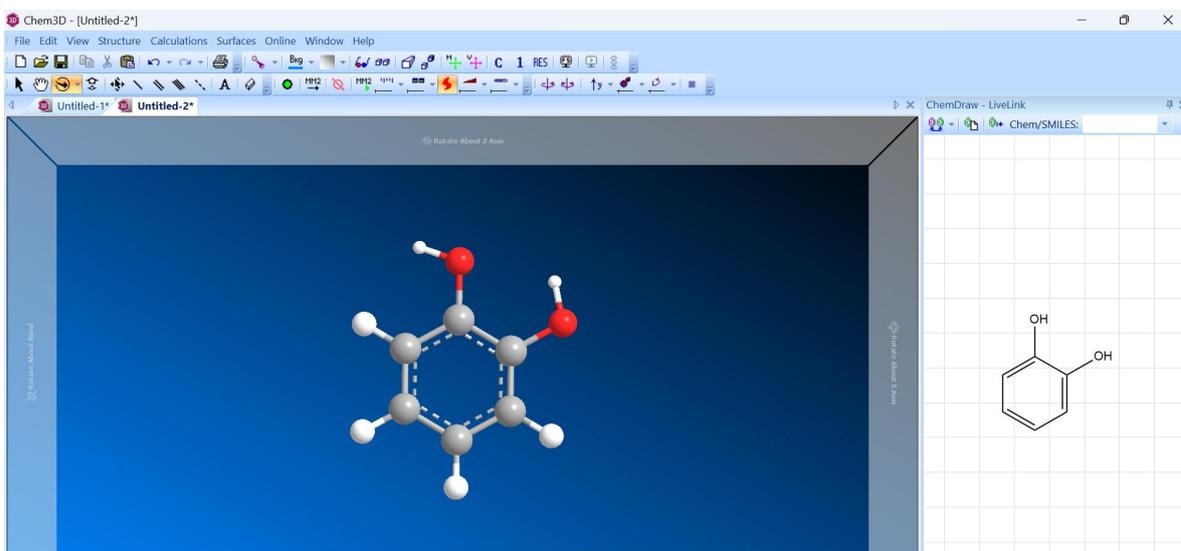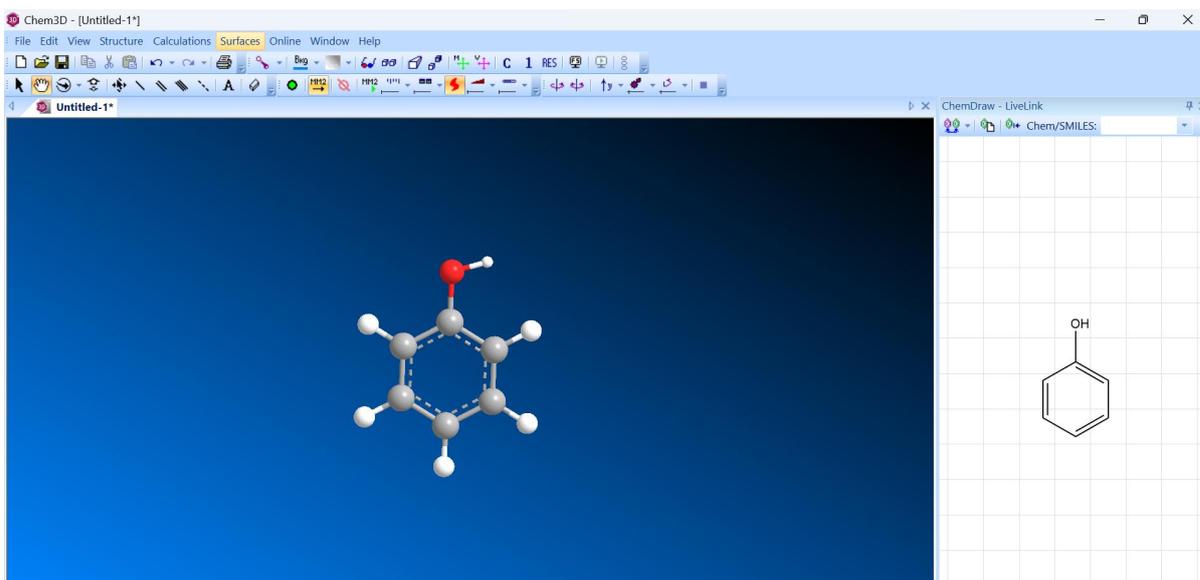

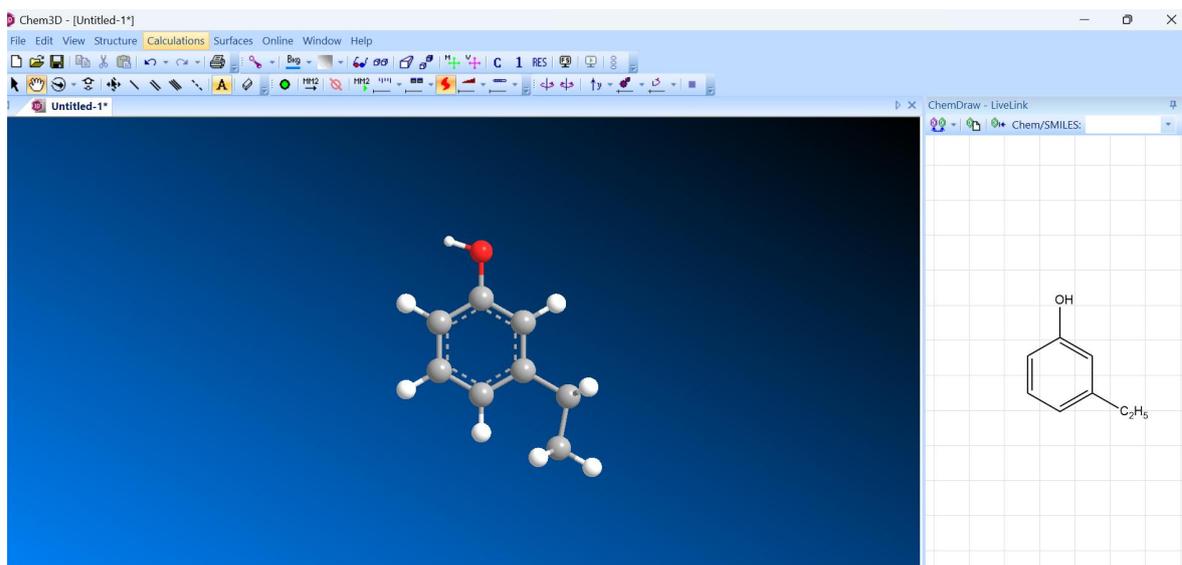**Figure 2. View of the phenol molecule in the HyperChem program [4, 16]**

Figure 3. 3D formulas of phenol and its derivatives in Chem3D

Figure 3 shows spherical 3D images of phenol and its derivatives. The use of such chemical programs not only in lectures, but also in practical and seminar classes allows students to expand their ideas about organic chemistry and organic compounds, enrich their worldview, and get more information about them.[3]

In conclusion, the use of modern chemical programs in organic chemistry classes allows students to imagine chemical organic compounds, study their properties, and anticipate chemical experiments based on them.

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