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ARTICLE *in* JOURNAL OF CHEMICAL EDUCATION · MARCH 2011

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MOLinsight: A Web Portal for the Processing of Molecular Structures by Blind Students

Florbela Pereira,* João Aires-de-Sousa, Vasco D. B. Bonifácio, Paulina Mata, and Ana M. Lobo

CQFB and REQUIMTE, Departamento de Química, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal

**florbela.pereira@fct.unl.pt*

The representation of molecular structures is a major challenge for the accessibility of blind students to chemistry, particularly organic chemistry. Learning organic chemistry is impossible without the reception, interpretation, and transmission of molecular structures, and these are commonly processed visually, by means of chemical drawings.

At the same time, information technology revolutionizes the life of blind people to an extent difficult to imagine by sighted people. Computer interfaces for visually impaired users, such as text-to-speech software and text-to-Braille refreshable displays, enable the proficient manipulation of nongraphical applications and data, as well as the access to the Internet.

Chemoinformatics can immensely assist blind students in the processing of molecular structures. Computers store molecular structures not only as drawings but also as graphs, that is, by specifying atoms, their bond connections, and their geometrical configuration. The BrailChem Web service *(1)* has no graphical user interface (GUI) and enables the navigation of molecular structures by visually impaired users. Some years before, the Kekule program *(2, 3)* was published with a similar purpose, which interactively provided information about the presence of atoms, bonds, and substructures.

Recently, we developed a prototype of a molecular editor for blind users, the NavMol program, that enables the interpretation and creation of molecular structures. The user can load a molecular structure stored in the MDL Molfile format and navigate from atom to atom receiving information about the element of each atom, its charge, neighbors, and bond orders. With the NavMol program, atoms and bonds can be added or deleted, bond orders changed, and the new molecular structure saved (Figure 1). The program relies on one of the simplest possible technologies, a command-line MS-DOS or Linux shell application. Such an interface exclusively requires the input and output of text and is reliably accessible through the keyboard and the common computer interfaces for visually impaired users.

The MOLinsight Web portal *(4)* (Figure 2) is a gateway to open-source software *(5−7)* as well as software freely accessible *(8)* to students that can be integrated in strategies for blind users to process chemical structures. It also includes documentation for the programs, and a guide to common tasks.

In our experience with a small number of blind students, we found the combination of all these strategies and IT chemical tools to be extremely efficient for teaching chemistry, enabling the communication of chemical structures between blind and sighted people.

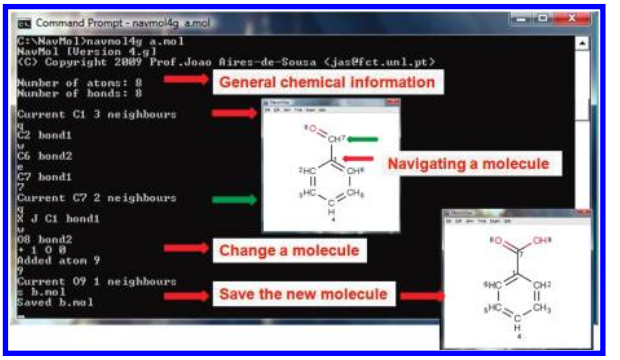

Figure 1. Exploration of benzaldehyde with the NavMol and building of benzoic acid.

Figure 2. The MOLinsight logo.

Acknowledgment

This work was supported by grants from the EU-LEONARDO DA VINCI Programme and Fundação para a Ciência e a Tecnologia (Lisbon, Portugal).

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10.1021/ed100723v Published on Web 12/16/2010

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Supporting Information Available

Tutorial on the handling of molecular structures by blind users. This material is available via the Internet at http://pubs.acs.org.

