

**EFFECTIVE METHODOLOGICAL APPROACHES TO TEACHING THE
PROPER AND SAFE USE OF LABORATORY GLASSWARE IN
CHEMISTRY EDUCATION**

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Laboratory sessions are an integral part of chemistry education, providing students with the opportunity to integrate theoretical knowledge with practical skills. In this process, glassware plays a central role, as it is used in nearly all experiments [1]. The correct selection, use, and storage of glassware ensure not only the accuracy and reliability of experimental results but also laboratory safety. Therefore, it is essential for students to thoroughly learn the proper procedures for handling glassware [2].

Providing students with theoretical knowledge about the types, shapes, and functions of glassware forms the initial stage of the methodological process. For example, test tubes are used for small-scale experiments, flasks are employed for preparing and mixing solutions, measuring cylinders are utilized for accurate volume measurement, and pipettes are designed to transfer precise amounts of liquid. When the functions of each piece of glassware are correctly explained, students learn to choose and use them properly during laboratory work, performing experiments safely and effectively [3].

Practical laboratory exercises constitute a critical part of teaching students to use glassware. The instructor demonstrates under which conditions glassware can be used and explains the necessary precautions. For instance, students learn not to place glassware not intended for heating over flames, not to place hot glassware on cold surfaces, and to perform precise measurements in volumetric equipment. These practices help develop solid skills, minimize errors, and prevent potential hazards.

Special attention must be given to integrating theoretical knowledge with practical exercises. The teacher first introduces the general characteristics and functions of glassware, and then demonstrates their use in a laboratory setting. This approach strengthens students' knowledge and simultaneously fosters independent working skills. Group work, collaborative experiments, observation, and drawing conclusions also produce effective learning outcomes.

Laboratory safety is of paramount importance, and students must strictly adhere to safety precautions while handling glassware. Regular emphasis on preventing breakage, proper cleaning, washing and drying used glassware, and removing chemical residues instills a sense of responsibility, technical discipline, and diligence. At the same time, the use of interactive exercises, demonstrative examples, video lessons, and multimedia tools enhances engagement and makes the learning process more effective and interesting.

Teaching the proper use of glassware not only develops practical skills but also fosters scientific thinking, analysis of experimental results, and responsible behavior. Students who master correct glassware usage perform experiments safely and accurately, collaborate effectively in group activities, connect theoretical knowledge with practice, and prepare for future independent scientific research. Therefore, methodological approaches to teaching the use of laboratory glassware play a crucial role in improving the effectiveness of chemistry education, developing students' professional competencies, and fostering a culture of safety in the laboratory.

References

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2. University of Pennsylvania Environmental Health and Radiation Safety. Fact Sheet: Glassware Handling. 2022.
3. Carolina Biological Supply Company. Lab Safety and Techniques 101: Introducing Your Students to the Chemistry Lab. 2017.