From the Ordinary to the Exceptional: A Study of Quantitative Analyses in Lab Courses

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The purpose and value of laboratory courses remain subjects of an ongoing debate, [1] and while general recommendations exist,[2] little is known about similarities and differences in approaches. Quantitative analytical experiments are a common feature of student laboratory courses across institutions and disciplines. Yet, discussions have often focused on instrumentation[3] rather than broader analytical or pedagogical aspects.
This contribution presents the results of a comprehensive literature survey[4] of 160 articles published between 2014 and 2024 in the Journal of Chemical Education that describe hands-on experiments for students involving quantitative analyses. Each experiment was categorized according to analytical and pedagogical criteria. The resulting compilation serves as a valuable resource for instructors seeking inspiration for experiments.
Beyond providing an overview of available experiments, the analysis offers additional insights, e.g. conveying the range of quantified analytes, utilized sample types, and employed quantification approaches as well as instrumentation. Pedagogical practices such as provided instruction, group work, and assessment strategies were also examined. While the surveyed experiments cover a broad spectrum of topics and methods, several potential gaps were identified. Based on these findings, specific recommendations for quantitative analytical experiments in student laboratory courses are proposed.

[1] Bretz, Evidence for the Importance of Laboratory Courses, *J. Chem. Educ.*, **2019**, *96*, 193−195, doi: 10.1021/acs.jchemed.8b00874; M.K. Seery, Establishing the Laboratory as the Place to Learn How to Do Chemistry, *J. Chem. Educ.*, **2020**, 97, 1511-1514, doi: 10.1021/acs.jchemed.9b00764.
[2] M. K. Seery, H. Y. Agustian, F. V. Christiansen, B. Gammelgaard, R. H. Malm, 10 Guiding principles for learning in the laboratory, *Chem. Educ. Res. Pract.*, **2024**, *25*, 383-402, doi: 10.1039/D3RP00245D.
[3] M.C. Conner, J.R. Raker, Instrumentation Use in Postsecondary Instructional Chemistry Laboratory Courses: Results from a National Survey, *J. Chem. Educ.*, **2022**, *99*, 3143-3154, doi: 10.1021/acs.jchemed.2c00415.
[4] G. Schwarz, Literature Survey on Quantitative Chemical Analyses Experiments for Students: Exploring Choices, *J. Chem. Educ.*, **2025**, *102*, 3468-3484, doi: 10.1021/acs.jchemed.5c00706.