Design and Testing of Laboratory Instruction Management System (LIMS)

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Laboratory Integration Management Solution (LIMS) is a software/hardware system which is used in industrial laboratories for the integration of all laboratory software and instruments, training laboratory users, QA and QC. LIMS may also support data mining, data analysis, and decision making. In this project, we propose to introduce Laboratory Instruction Management System thus redefining the acronym LIMS.

In chemistry educational laboratories, paper based laboratory notebooks and paper reports create an obvious bottleneck. They take hours of student's time; they also overload the instructor with enormous amount of reading (40 - 60 pages of a notebook with multiple attachments plus over 100 pages of reports per student per semester). Purchasing paper notebooks and printing supplies dramatically increases the education costs. All these expenses, both time -related and financial, can be eliminated or at least dramatically reduced by implementation of LIMS. Electronic notebook was designed to replace traditional, paper - based methods of documentation. Students plan and document all aspects of an experiment from execution to results; laboratory instructions will be incorporated into a template and adjusted at time of preparation for a new lab experiment. Report preparation can be simplified by integrating with existing data acquisition system to reduce clerical errors and provide the ability to search on previous experimental results.

The obvious challenge is the necessity of incorporating numerous instruments controlled by various types of microprocessors and devices running different operating systems (various versions of Windows, Linux, Android, and iOS) with wired and wireless connection. Concurrently, the user interface must be simple and easy to learn in order to direct student attention towards studying the subject (in our case – various chemistry disciplines) and not spending extra time on learning software. Special challenge is coming from use of non-electronic devices, e.g. traditional glass burets and pipets. We study and discuss the ways to overcome this obstacle. A number of data acquisition software options were employed: NI Labview, Vernier LoggerPro, home-made macros for Excel, as well as proprietary programs from instrumentation manufacturer. In addition to professional cameras, several types of smart phones and tablets were tested for image and video recording. The resulting report format was a PDF file with appropriate link to data analysis files and raw data in electronic notebook.

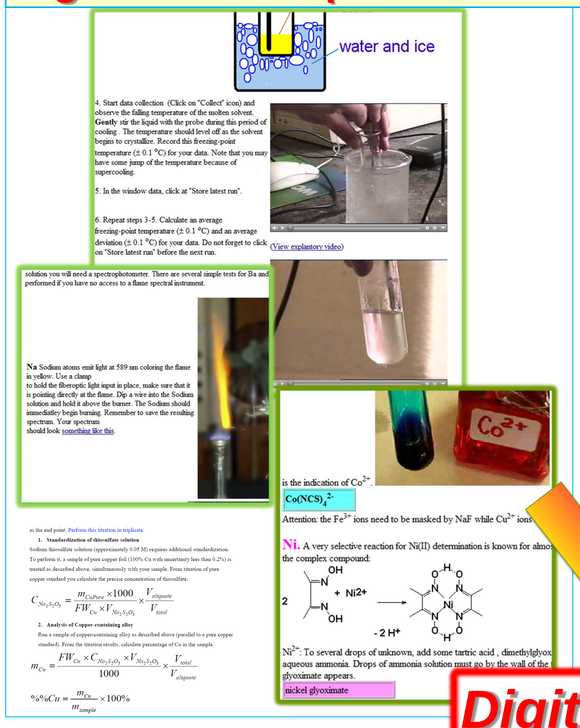
The system was tested with participation of students from Analytical Chemistry and General Chemistry classes in 2012 - 2013.

A.Y.Nazarenko, N.A.Nazarenko. Analog Spectrophotometers in the Digital Age: Data Acquisition on a Budget J.Chem.Ed., 82, 294(2005)

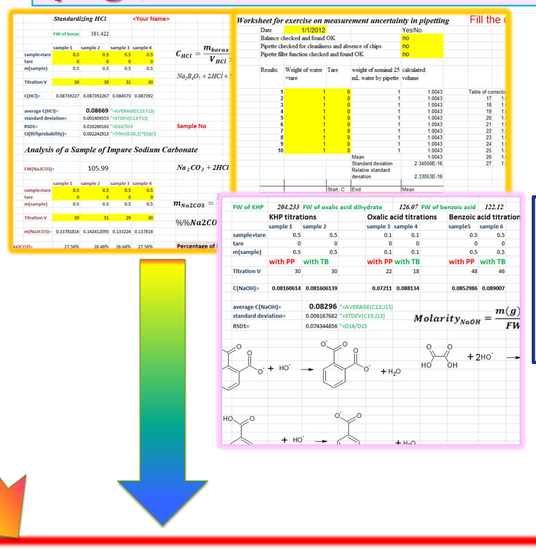
M.S.Goodman, K.F.Jonmaire, and A.Y.Nazarenko. Contemporary Undergraduate Qualitative Analysis: Use of CCD-Based Raman, Atomic Emission, and Reflectance Spectrometers. Spectroscopy Letters 40, 253-463(2007)

A. Y. Nazarenko, Optical Sensors for Manual and Automatic Titration in Undergraduate Laboratory Spectroscopy Letters,43, 555–560 (2010)

Digital manual (lab instructions, images, video)

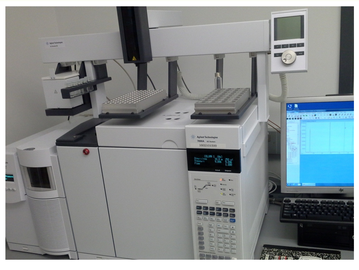


Digital notebook template (e.g., Excel or PDF form)



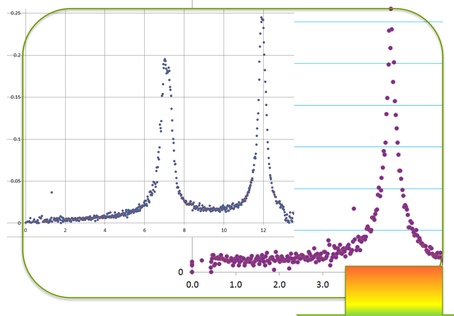
Instructor Input and Corrections

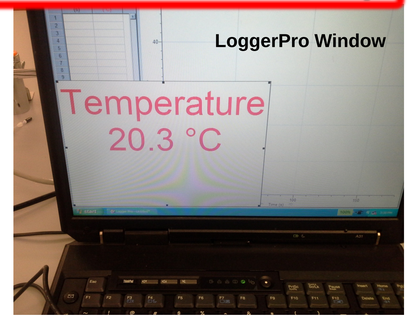
Digital Collection and Processing (e.g., LabView, LoggerPro, Collect6.1)



Electronic balances with RS-232 or USB *instead of manual read*

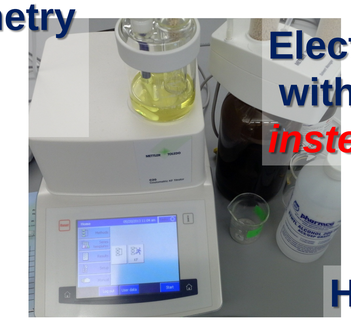
Automatic Digital Data transfer





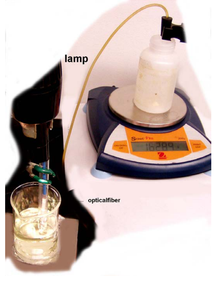
Chromatography/Mass Spectrometry with network data transfer *instead of manual separations*

Electronic titrators with RS-232 or USB *instead of glass buret*



Thermogravimetric Analysis with RS-232 *instead of manual gravimetry*

Home-made automatic electronic titrators with RS-232 or USB *instead of glass buret*



Automatic Report Creation (e.g.,PDF)

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