A Problem Oriented Approach to Understanding Analytical Chemistry and the use of Portfolio Assessment

by Mary Boyce, Kuki Singh

Experiment Overview

The experiment/problem orientated approach described here is designed to maximise student engagement in the learning process. Specifically, it is about students being responsible for their learning, for them to undertake some self directed and independent learning, to work collaboratively with their peers, to read the literature, to design, plan and carry out some experiments, to manage their time and finally to provide evidence of their learning. In an effort to achieve these aims and to fully and transparently give the students the responsibility for their learning the traditional lecture, and laboratory slots were abolished. The laboratory was used to drive the learning process which provided the impetus for self directed learning. To further support this approach the assessment had to be radically changed. Students were asked to submit a portfolio which provided evidence of their learning and contained the following elements: a summary of the issue/problem to be addressed, a laboratory report, examples of self directed learning, examples of shared learning resources and a reflective log. In this paper emphasis will be placed on the laboratory component but there will be some discussion of the other student learning elements.
The lecturer chose amino acid analysis as the problem/issue to be addressed by the students. It was chosen because it provided an example of a sample that is not ideal for chromatographic analysis. Amino acids are non-volatile making them unsuitable for direct analysis by GC and they lack a strong chromophore making them unsuitable for HPLC or CE with direct UV-Vis detection (for sensitive detection).
In week 1, the students worked in groups reviewing the reading material provided. As a class the students framed the issue they were going to explore for the next 6 weeks - “Detection issues in the analysis of amino acids by HPLC and GC”. Students (in pairs) then elected which technique they were going to concentrate on in the first few weeks with idea of rotating after 3/4 weeks.
In week 2, the students came back with rough procedures, chemical lists and lots of questions. At the end of this session, students had refined their procedures and went away to prepare a requirements sheet for week 3 when they were going to complete some experiments. Some snap shots of the path taken and challenges encountered by one pair of students investigating amino acids using evaporative light scattering detection is presented here. The other aspects of student learning will also be included. For example, the type of self directed learning items and shared learning resources produced by the students to support their learning.

Level of Experiment

This type of experiment is best completed by students who have a basic understanding of chromatography and have previously used a HPLC unit. However, the overall aim or structure of the learning process can be adapted to suit any level.

Keyword Descriptions of the Experiment

Domain
analytical chemistry

Specific Descriptors
chromatography, amino acids, inquiry-type experiments

Course Context and Prerequisite Knowledge and Skills

At ECU our students complete a Bachelor of Technology (Applied & Analytical Chemistry) Degree. This degree has a significant TAFE component in first and second year and as a result our chemistry majors have good hands on instrumentation skills. In third year, our students complete several analytical chemistry units at ECU, one of which is Analytical Chemistry I where the main emphasis is on chromatographic techniques including HPLC, gas chromatography and capillary electrophoresis. The laboratory activities are described in a laboratory manual that supports the unit. Experiments in HPLC, GC and CE tend to involve samples that are highly suited to the technique e.g. ethanol in wine and fuels by GC, caffeine and preservatives in coca cola by HPLC and cations/anions by CE.

Time Required to Complete

Prior to Lab: 2 hours per week, for 6 weeks
In Laboratory: 5 hours per week, for 6 weeks
After Laboratory: 3 hours per week, for 6 weeks

Experiment History

This activity was developed by the authors listed and will be published in 2007.

Comments

Mary Boyce would like to acknowledge the 3rd year students who enthusiastically embraced this approach to learning.