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Peer Teaching: Taking the Recipe out of Food Analytical Chemistry

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Paper # 10 Peer teaching: Taking the *Recipe* out of Food Analytical Chemistry

Abstract

This presentation describes the implementation over several years of an alternative to 'recipe-style' laboratory practicals for a group of penultimate third year students studying applied chemistry as part of a four year BSc Nutraceuticals degree. The main objectives of the laboratory re-design are to better prepare students for the more independent final year research project which takes place in fourth year, and to integrate key employability skills into the curriculum. The approach retains many of the 'tried and tested' food chemistry experiments, but involves using a group peer-teaching methodology which aims to add value to the experience for the students. The anticipated added value includes: improving research skills through trouble-shooting and optimising experiments; academic writing skills through preparing teaching resources; oral communication and presentation skills through peer-teaching; and employability skills through group organising and planning.

Student evaluation, focussing on a cohort of students' *perceptions* of preparedness for final year projects and placements after the chemistry practicals in third year, and re-visiting the cohort following their final year projects and work placement, will be presented.

Finally, the approach has seen several iterations, some of which were due to personal reflection and student feedback, and some enforced through increased class sizes and reduced class contact hours for practicals. The presentation will highlight how various technologies were successfully utilised to overcome some of the barriers to retaining the pedagogy, and consider how resource issues impact on student learning. For the benefit of practitioners, assessment and feedback mechanisms will be discussed. Furthermore, insights into food analysis will be apparent, which may be of interest to those teaching general chemistry courses as a means to add context to chemistry practical work.

Theme: Inquiry-based learning

Type: Oral presentation

Extended abstract

Introduction

Rationale

The aim of the overall project was to redesign the practical element of two co-requisite stage three Food Chemistry modules in a BSc Nutraceuticals honours degree programme, however the rationale for the redesign could also be transferred to any year three practical subject.

Taylor and Geden (2008) describe fourth year students who, up until final year projects, believed 'most chemistry worked'. This is owing to the nature of traditional verification or expository laboratory teaching methods (Domin, 1999), where students follow a given procedure to obtain a pre-determined outcome. A more ideal approach integrates application of knowledge to solve problems, group work, and an opportunity to design experiments, including consideration of the safety aspects (Bennett *et al.* 2009). A recent IBEC Education and Skills survey (2010) continues to highlight that action is required to develop graduate 'employability' or 'generic' skills. Yorke (2004) describes employability in terms of management of self, others, information and task. Development of employability skills provides the rationale for this project which aims to incorporate all aspects into the practical work through a peer-teaching pedagogy, thus preparing students both for final year research projects and for subsequent entry to the workplace. This represents a significant change in student activity, compared to their other modules, both in their current year, and in the previous years of their degree.

Background

Over the last several years, students have worked in groups to 'run' their own chemistry labs. The tasks required to achieve this, and the associated learning outcomes/skills are outlined in Table 1. The skills broadly map onto Yorke's expanded explanation of employability.

Table 1. Peer teaching tasks, aligned learning outcomes and assessment

Task	Aligned Learning Outcome/ Skill	Assessment*
Group work	Overall management of self, others, information, and task	Wiki (*product*) and peer assessment (CATME) (*process*)
Researching the background of the experiment	Independence, information retrieval, critical analysis, research skills	Observation and wiki
Risk assessment	Health and safety considerations	Wiki
Troubleshooting and adapting the method	Adapting to new challenges, initiative, critical thinking, problem solving, research skills	Observation and questioning
Writing a suitable student manual	Written scientific communication	Wiki
Preparing a pre-practical presentation, including introduction to the practical, the method, and the safety	Creativity, written communication, applying subject understanding	Wiki
Liaising with the technician/lecturer to organize consumables/ equipment/	Prioritising, planning	Observation and questioning

glassware		
Giving the pre-practical presentation	Oral communication, explaining	Presentation
With the assistance of the lecturer, aiding the smooth running of the lab	Organisation, problem solving, oral communication, explaining	Observation
Giving post-practical analysis, including managing results	Applying subject understanding, explaining	Observation

*A Laboratory report and poster report were also associated with the module, but not related to the peer-teaching component

In earlier iterations of this teaching model, with fewer students and longer hours, it had been possible to allow each student group to carry out the peer-teaching task twice: once in the Food Chemistry I module in the first semester, and again in the aligned Food Chemistry II module in the second semester (Dunne and Ryan, 2012). The skills could be built up at a slow pace over the course of the two modules, with more preparation time for students (including face to face contact with the lecturer) ahead of peer teaching sessions. Typically, the students were given the opportunity in the second semester to develop an experiment from a list of suggestions through adapting literature methodology. Student evaluation-through surveys and structured focus groups- of the 2010/2011 and 2011/12 third year class demonstrated a very positive *perception* of having developed employability and research skills. Results of this evaluation will be presented. In addition, the 2011/12 cohort will be revisited following their fourth year project and work placement carried out in 2012/13, to determine if the development of these skills was in fact realised.

Adapting model to accommodate resource issues:

In 2012/13 the third year class size has grown from typically 16-20 students to 28 students per laboratory session, supervised by one lecturer and one teaching aid. Concurrently, to bring the modules in line with institute norms, there has been a reduction in contact hours for the practical, from 12 x 3-hour sessions to 8 x 3-hour sessions. This has required a restructuring of the peer teaching format, and the reliance on technology to address key management and teaching issues. These issues will be explained and aligned to the technologies summarised in Table 2. The restructuring has led to what is now considered a sustainable approach, which has retained many of the core objectives, and can accommodate the maximum capacity of the laboratory (up to 32 students). The potential impact of the resource reduction on student learning compared to the original model will be probed.

Table 2: Technologies utilised to support organisation, assessment and feedback of 'Peer teaching' pedagogy

Technology	Software used	Purpose
Online fat extraction experiment package in *Articulate Presenter*	*Articulate Engage*	Provide students and teaching aid with instructional video, student and technical manual, online glossary, pre-practical MCQ quiz.
Wiki	*Blackboard wiki tool*	Allow group collaboration to develop, receive lecturer feedback, and share student developed resources for peer teaching.

Online peer assessment surveys	*CATME**	Assessing the group work *process*: A fair, robust, comprehensive and anonymous online peer assessment
Online peer generated MCQ quizzes	*Peerwise*	Pre-lab engagement: Allows peer teachers to develop quizzes to help prepare class for laboratory session
Interactive in-class MCQ quizzes	*'Clickers' and Turning Technologies software*	In-lab engagement: Allows peer teachers to develop an interactive presentation with multiple choice questions to engage class in experimental theory.
Podcasts	*Audacity*	Summary feedback / instructions for report writing

A very brief overview of some of the types of experiments carried out in the Food Chemistry labs will be provided (as outlined in Table 3). The reason for this is twofold. Firstly, to allow the audience to conceptualise the practical curriculum (which may be less familiar to many chemists). Secondly, to make the presentation more relevant for teachers of practical courses. Many of the food chemistry experiments can be carried out in a standard chemistry lab and could provide a real-life context to similar techniques in a general chemistry course, whilst providing an additional challenge for students as food sample preparation is more complex than a typical chemistry work-up. Table 3: Examples of Food Analysis Methods (adapted from industry methods)

Experiment	Sample preparation	Analysis
Extraction of fat from chocolate	Hydrolysis	Gravimetric after soxhlet solvent extraction and concentration
Hydroxymethylfurfural in Honey	Protein and fat precipitation	UV spectroscopy
Salt in butter	Heating and extraction	Silver nitrate chloride ion titration
Copper in tea	Wet ashing	Atomic absorption spectroscopy
Quinine in tonic water	Degassing and dilution	HPLC
Antioxidants in vegetables	Drying, grinding and extraction	UV assay
Sugar analysis in condensed milk	Protein and fat precipitation	Polarimetry

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