

國科會計畫

計畫編號: NSC96-2511-S018-008-MY2

研究期間: 9608-9707

開發探究為本和發現導向的日常生活化學實驗整合於普通化學實驗
課程 (I)

Development of Inquiry-Based / Discovery-Oriented and
Daily-Life-Related Chemistry Experiments Integrated into General
Chemistry Laboratory

楊水平

中文摘要

普通化學實驗使用的藥品和器材絕大多數來自於制式的實驗室，鮮少利用消費者產品，其缺點是探究過程過於理想化而不切實際，常常不能運用到複雜的自然世界，也無法真正的融入生活化學之中，導致學生學習的興趣低落，因而解決化學的能力不足。本研究計畫的目的是開發適用於普通化學實驗課程的兩個主題以探究為本和發現導向的日常生活化學實驗，以提高學生學習化學實驗的興趣。第一個主題為『誰的呼吸效能最好？』包含二個實驗單元；第二個主題為『個人化、藝術化肥皂的製造』包含三個實驗單元。在評估本計畫的實驗設計之可行性方面，有實驗數據者以量的分析為主：(1)以 two sided F test 和 standard deviation 分析研究者和學生的實驗結果之偏差程度，以及他們兩者之間的實驗精確度是否達到顯著水準的差異；(2)以 two tailed t test 比較研究者與學生之間的實驗平均值之間是否達到顯著水準的差異。在探究實驗教材的開發上，以質的分析為主並且採用多元的評量方式。本研究結果將撰寫成為包含學生教材和教師指引的文章投稿於化學教育期刊，此教材可以立即地到國內外的大學普通化學實驗課程使用，以及編入普通學實驗教科書之中。

關鍵字：普通化學實驗；實驗設計；消費者化學；家用產品；酸鹼滴定；定量分析；化學動力學；發現學習；科學探究和探究教學；

Abstract

How much is the exchange percent of oxygen gas and carbon dioxide gas between the air and the blood in the lungs? We attempted to design a novel experiment to determine the content of exhaled carbon dioxide. The carbon dioxide can be reacted with sodium hydroxide to produce a sodium hydroxide and sodium carbonate solution. Students challenged to find optimum indicators through discovery method learning for acid-base titrations to quantitative analysis the carbon dioxide. The titrations involved three equilibrium points and three end points. This study concludes as follows: students found that three optimum independent indicators used as 2nd end point detection for acid–base direct titration are thymol blue (relative error: -0.66%), and phenolphthalein (0.87%). Furthermore, students also found that six optimum dependent indicators used as 2nd and 3rd end point detections for acid–base differential titration are thymol blue and methyl red (relative error: -1.37%), thymol blue and methyl orange (0.04%), thymol blue and congo red (0.26%), phenolphthalein and methyl red (0.15%), phenolphthalein and methyl orange (1.57%), and phenolphthalein and congo red (1.78%). We found that optimum indicator chosen simply by the derivative end point methods is not satisfactory and successful evaluation of its feasibility is necessary. Evaluation of its feasibility through discussing and modifying is also necessary. This experiment described in this article has served as an excellent introduction to the use of statistical methods in analytical chemistry. The discussion for evaluating the indicator feasibility helps the students gain a better perspective on the interpretation of data.

Key words : General chemistry laboratory; Experimental design; Consumer chemistry; Household products; Acid-base titration; Quantitative analysis; Chemical kinetics scientific inquiry; Discovery-oriented learning; And inquiry-based approach