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大學安全衛生通識課程的發展與成效探討

Development and effectiveness of an occupational health and safety course in college general education

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中文摘要

將安全衛生教育往學校教育扎根之概念發展的很早，但多年來不論中外，安全衛生教育的相關討論仍多著墨於安全衛生專業教育或特定科系的需求，關於讓一般學生廣泛學習安全衛生教育的嘗試與討論並不多見。基於所有學生畢業後終將進入各式職場成為重要的人力資源，將安全衛生之概念融於學校教育中使學生有所認識，早一些進行從認知到態度之養成，除了可在日常生活中避免相關意外的發生，也可對於將來職場上落實安全衛生管理與接受教育訓練成效有可預期之正面助益。

由於各國之教育制度不甚相同，可供融入安全衛生教育之機會與方式也有所不同，故迄今各國或各有不同之嘗試。台灣現今的社會與教育發展趨勢因大學錄取率大幅提升而導致進入職場的學歷幾乎已提升至大學畢業，且台灣的大學通識教育提供了一個可能的管道將安全衛生提供給所有的學生，因此推行大學安全衛生通識課程的想法於焉產生。這是一項有別安全衛生教育訓練與安全衛生科系專業培育的新課程，因此如何建立合適的課程內容以吸引大學生的學習興趣，並確實發揮其教育功效即為本研究的探討內容。課程發展前須先了解受教者的需求，因此進行一項全面性的抽樣調查以了解學生學習意願，進而建立一學期二學分的安全衛生通識課程架構及發展課程內容模組。課程模組初步建立後藉由實際修課學生之表現進行內容評估，以了解課程內容是否能達到讓修課學生的認知所有提升之基本要求。在課程大致符合此項要求後，採用其中八項議題內容形成一教學介入，採「不等的前測－後測控制組設計」評估此教學介入對於學生安全衛生知識、態度、自我效能與行為意向的成效。

共有 933 位大學生參與課程內容評估，結果顯示此安全衛生通識課程能顯著提升修課學生的安全衛生認知。且僅有 2 項議題-人因工程與電腦作業危害顯示自然科學背景的學生比社會科學背景學生的學習成效更佳，其他議題的學習成效則未受到學生科系背景不同而有所不同。而介入的評估結果則顯示綜合了介入與重複施測的刺激，介入組在認知、態度、自我效能與行為意向均有顯著的提升，且進步可持續至介入結束後一個月。綜而言之，安全衛生通識課程對於少有機會學習安全衛生的大學生提供一扇認識安全衛生的窗戶，並能協助學生更妥善的面對與處理現今生活中的安全衛生相關問題以及未來可能面對的職場挑戰，因此建議大學校園能更廣泛提供此類課程供更多的大學生有學習的機會。

關鍵字:安全衛生教育、通識教育、課程發展、教學成效評估

Abstract

The concept of integrating occupational health and safety (OHS) into general education during early career training has been introduced before. However, the OHS education focused largely on the on-the-job workplace trainings and the professional developments of OHS specialists. There were some discussions about OHS curriculum need of specific majors in school, but limited discussion about providing OHS education for general college students. Learning OHS at colleges could be a pre-employment training for college students, so to provide the OHS information before the individual enters the workplace on campus should be important.

Most undergraduate students eventually enter the workplace and they would not have much opportunity to take the OHS related courses in their previous schooling before taking jobs. Therefore, the Ministry of Education in Taiwan initiated ISHALE (Integrate Safety and Health Awareness in Liberal Education) program in 2004, which was designed to enhance college-level occupational health and safety education. The principal goals of this work were to provide the OHS general course modules and to assess the effectiveness of this course.

Before developing OHS general course modules, a comprehensive questionnaire survey of college students in Taiwan was conducted during 2003-2004 to assess student awareness of, and interest in, OHS topics and personal factors that may influence the motivation to take college OHS courses. A two-credit general education course including 16 OHS topics was then developed according to the results of this nationwide survey. A before and after study design without a control group was used to evaluate the students' OHS knowledge improvement by this course between 2006 and 2007. Thirty-nine multiple choice questions were utilized to assess students' OHS knowledge of 13 topics. After the primary assessment of the course content, a quasi-experimental, nonequivalent control group design with pre-post-follow-up tests was utilized to evaluate the intervention effects, which included OHS knowledge, attitude, self-efficacy and behavioral-intention of students in 2007 school year. The intervention design included eight topics and the evaluations were performed three times - a pretest at the first class meet, a posttest at the week after the eight topics were completely taught and a follow-up test in four weeks after the posttest week.

A total of 933 students enrolled in elective OHS classes at 18 colleges completed both pretest and posttest. The overall content was found to be appropriate to most enrolled students. Furthermore, participants' knowledge, attitude, self-efficacy and behavioral-intention improved significantly by the intervention. The improvements were still significant at the follow-up test. This OHS

general course opened a window to the young adult to acquire certain OHS knowledge that might be misunderstood or unknown before. Through this window, students learn the basic concepts of OHS and promote their learning interest in OHS. Therefore, the OHS general education program should be offered for all undergraduate students. Giving students the opportunities to explore OHS shall be an important seeding for further OHS training at workplace after their completion of school education.

Keywords: Occupational health and safety education, curriculum development, program evaluation

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第一章 研究背景

將安全衛生教育往學校教育扎根之概念發展的很早(1)，但多年來不論中外，並未見有太多安全衛生教育存在於校園的課程規劃中。現今與校園有關的安全衛生相關文獻仍多偏重於安全衛生環境或管理制度之調查研究(2-10)，論及安全衛生教育訓練部分者也多著墨於安全衛生科系的教育課程討論(11-14)或是特定科系(如化學系)的教育需求等(15-16)。僅少數的文獻針對非安全衛生專業科系學生提供安全衛生相關教育有所討論(17-22)。

美國職業安全衛生研究所（NIOSH）於 1987 年所試行的 2 個合作計畫（Project Minerva and Project SHAPE）(17)，分別與商業學校及工程科系合作將安全衛生教育引入其原有的教育過程，雖然有關教育成效的結果很難在短期內觀察的，但與商業學校的合作獲得正面的回應，而與工程科系的合作計畫則持續發展並於 2003 年完成 9 個教學模組放置於 NIOSH 網頁上供需要者自行免費下載(18)。

美國阿拉斯加州於 1992 年開始於高中推行的工作危害認知計畫（Job Hazard Recognition Program）(19)，該州健康計畫（Alaska Health Project）係基於學生在正式成為職場勞動者前就可以接受的工作危害認知教育之想法而開始推展此項子計畫，在推行數年後發現該課程造成幾點影響包括不少學校的接受度很好，必須有足夠的訓練才能有效進行課程的整合工作，以及學校老師、校護及管理者也意識到其應該重視與維護其自身工作環境的安全衛生品質等。不過該計畫由於合適教師的培訓工作因經費問題而無法順利進行而導致計畫暫停，該計畫仍持續嘗試其他機會將此種工作危害認知教育概念推廣進入校園。

1998 年以色列報告一項對 11 年級學生(16-17 歲)進行職業健康教育(occupational health education program)的評估結果，該項教育介入為期 3 個月，共有 196 位學生參與(實驗組 96 位、對照組 100 位)，以自填式問卷分別於介入前後進行評估。結果為實驗組學生在知識(knowledge)與態度均顯著高於對照組，顯示在高中階段實施職業衛生課程是可行的(20)。

2003 年中國長沙進行一項針對醫學院護理系學生預防血液傳播疾病與針扎傷害的教育介入研究，共有 106 位已完成 3 年教育課程即將進入醫院實習的學生隨機進入實驗組(56)與對照組(50)。該項教育介入包括 60 分鐘課程與 20 分鐘的影帶

觀賞，課程與影帶內容包含血液傳播疾病的流行病學、傳播、職業暴露模式與一般預防措施與傷害後續管理等。使用自填式問卷於介入前與介入教育實施 4 個月後分別收集研究者的基本資訊與對一般預防措施的認知及職業操作行為資訊，另外 4 個月後實際針對實驗組(20 位)與對照組(18 位)進行行為觀察。同時兩組參與者於研究期間若有針扎意外發生均須提報。該研究結果顯示實驗組在知識與行為均顯著高於對照組，且有顯著較低的針扎意外發生率(OR=0.29, 95% CI=0.11~0.74, p=0.004)[21]。

而 2005 年 Wong et al.針對台灣高職美髮科學生進行化學安全知識與個人態度之相關研究，發現化學安全相關認知上得分較高者較不會反應「因為太忙而無法配戴個人防護具」(OR=0.45, 95% CI=0.21~0.95)，得分越低者其所具有的工作所用的化學物質所導致的長期皮膚暴露危害的認知也越低(OR=2.33, 95% CI=1.10~4.93)。因此該研究建議欲有效預防美髮工作者暴露於潛在化學性危害的須藉助維持安全的工作環境，而這樣前提的維持則必須依賴學校提供適當的相關化學品安全操作的教育與訓練[22]。

台灣本土有關學校安全衛生教育的相關研究並不多，但近幾年以學校安全衛生為題的碩博士論文數量有增加的趨勢[23-53]。依據全國碩博士論文資訊網的查詢結果(如表 1)，其中多數偏向現況調查居多。調查範圍多以環境危害、教師或學生的安全衛生認知與態度為主，針對校園安全衛生教育(或課程)的相關研究相對少數。此外，因台灣的教育體系中的技職體系以實務技術為導向，學生除繼續升學的選擇外，不少學生則是畢業後直接進入職場工作，故高職養成教育被視為培養學生正確安全衛生態度與習慣的適當時機與場所，因此以高職為研究範圍者佔大多數。

隨著台灣的社會發展趨勢與教育狀態的變化，進入職場前的學校已大幅提升至大學校院的層級。基於「全面培育未來職場上的工作者都具備基礎的安全衛生素養」理念，2000 年即有將安全衛生教育融入大學校院的通識課程的想法與建議[54]。因為大學的通識教育目的為提供學生的知識和技能，希望幫助學生活用於日常生活中，並進而成為終生學習的基礎。所以除了傳統的各種新生安全衛生教育訓練與安全衛生科系的專業培育課程外，建立「安全衛生通識課程」是一種新的嘗試。教育部環境保護小組曾有過 2 次的相關課程開發嘗試[54-55]，但並未隨即有

全面推廣的行動。直到 2003 年該小組著手擬定「實驗室（實習）場所安全衛生教育訓練六年推動計畫」企圖進行全面推廣，因此一連串的課程研擬與評估研究於焉展開。究竟課程應該呈現何種面貌才能達到前述目的，除了安全衛生專業的規劃外也應考量受教者的需求與看法。而課程時間有限，但安全衛生所包含的範圍又相當廣泛，如何設計出的符合專業期待又能吸引學生的學習興趣的課程即是本研究第一部分調查的主要目的。而課程模組建立後的實際教學成效評估更是課程發展時不可缺少的重要資訊，這即是本研究的第二部份-大學安全衛生通識課程內容評估與介入成效評估。

在本研究執行期間先後有國內其他單位進行與大學安全衛生通識課程有關的研究，摘錄如下:

2001 年張氏所進行的「環境與安衛通識課程教案評估研究」則是針對雲林科技大學所研發之「環安衛與生活」通識課程教案以自編問卷進行評估研究。以該校 70 名選修該課程之學生為調查對象，結果顯示：(1)科技大學的學生認為通識課程應具備實際應用的功能。(2)該教案內容設計豐富且規劃完整，對學生通識課程應有其一定效果，極具參考價值。(3)該通識課程教案較適於工程背景的學生，如要用於所有不同學院及科系背景之學生，仍須依據學生意見再做適度的調整及修改(51)。

2006 年伍氏所進行之「大專院校學生安全衛生教育評量成效與認知態度之研究-以南部大專院校為例」，係以自編評量表與問卷調查方式探討大專院校安全衛生通識課程的教學現況及其成效。以南部 10 所大專院校參與安全衛生通識課程 353 名學生為實驗組，另抽取同校其他通識課程 366 名學生為對照組，分別於學期初與期末進行評量。其評估的課程內容包含 18 項議題(實驗場所危害認知、安全衛生法規、危害通識、電腦作業危害預防、機械設備與安全、游離輻射、急救、非游離輻射、緊急應變、人因工程、個人防護具、噪音危害、化學性危害、實驗室廢棄物、呼吸防護、火災爆炸、電氣安全、生物性危害)，結果顯示經過一學期的安衛通識課程後學生對於安全衛生方面的態度及認知均有顯著進步 (52)。

2009 年林氏所進行的「一所教育大學實施環境安全與衛生防護課程成效之研究」則以量化為主質性為輔的方式進行台北教育大學的環境安全與衛生防護課程(含化學性危害、台灣地區公共衛生概況、食品安全衛生管理、生物性危害、人因

工程、電氣安全、電腦作業危害預防、輻射安全、個人衛生習慣與健康指標、實驗室安全衛生、噪音危害、個人防護具、火災爆炸、急救等 14 個議題)的學習成效。以該校兩班修習環境安全與衛生防護課程之 100 位學生為實驗組，另以兩班修習科學導論且未選修環境安全與衛生防護課程之 78 位學生為控制組，以自編的「環境安全衛生防護實施問卷」施以前後測並輔以質性晤談。結果顯示該課程對學生的環境安全衛生態度、認知有正面影響，並建議課程教學內容及方式，以貼近生活為主體，並多以討論及實際參觀操作的方式為佳及學校應定期舉辦和環境安全與衛生防護課程方面相關的教育活動(53)。

一般常見的學習成效評估方法包含使用測驗或評量表進行量化評估、或使用焦點團體訪談、教室學習觀察等質性方法評估。而針對不同的評量時間點（教學前、過程中與教學後）、不同的評量目標（認知領域、技能領域、情意領域）各有其適用之評量方法(56)。伍氏與林氏所進行的評估主題均是教育部於 2004 年開始推廣的通識課程，雖然課程範圍略有不同，研究對象特質與研究工具也有所不同，但均初步證實安全衛生通識課程對學生在安全衛生認知與態度有正向的提升效果。

在回顧安全衛生領域的相關文獻時可發現以針對不同職場上的特定項目教育訓練進行成效評估(57-65) 者居多，而整理(表 2)後亦發現該類型研究中「是否有合適對照組」及「評估成效的方式」兩點成為評估結果是否具備說服力的焦點。而此兩項因素常因研究對象特性不同而必須採取各種不同的措施。本研究擬評估的安衛通識課程其目的、受教對象、時間長度等特質與一般職場安全衛生教育訓練有著相當的差異，故在研究方法上也參考相關領域學校課程進行成效評估的經驗(21-22,65-71)。本研究第 3 部分介入成效評估項目除了認知與態度等項目外，增加自我效能與行為意向等面向，並嘗試進行學習成效之追蹤，希望能更全面了解該安全衛生通識課程是否達到預期之成效。

本論文包含了課程發展前所進行的「大學校院學生對安全衛生通識課程學習意願調查」、課程發展過程中進行的「大學校院安全衛生通識課程內容評估」與課程發展成熟後進行的「大學校院安全衛生通識課程介入成效評估」，其研究方法與結果將於後面章節分別介紹。

第二章 大學校院學生對安全衛生通識課程學習意願調查

2.1 研究方法

2.11 研究對象

本項調查的樣本以分層抽樣方式進行選取，依據台灣教育部於民國 92 發佈的大專校院基本資訊中的 16 學群(72)為分層依據，再依據每個學群所包含學系數目為每一層的抽樣母數，在抽樣誤差為 0.05 下訂出各學群之抽樣樣本數（詳如表 3），共計 239 學系。而每學群由哪些學系進行問卷調查則是以亂數表隨機抽樣出各學群中受訪之學系。每個學系的樣本數則是參考 Occupational exposure sampling strategy manual (73)中採樣樣本數之估算公式所計算出來，該公式包括下列幾項假設與設定：(1)每一學系有至少 10%的學生有意願選修安全衛生通識課程，(2)在 type I error α=0.1 設定下，(3)每學系有意願修課的學生中至少有一位學生被抽樣到，綜合前述條件所計算出每個學系樣本數為 22。故請受訪學系隨機請該系 22 位大學生填寫問卷後寄回。共發出 5258 份問卷。

2.12 問卷內容

本項調查使用不記名問卷方式進行調查，問卷內容主要有兩部分（詳見附件 1）：

（1）填答者基本資料及修課經驗，包含如學系、年級、性別、填寫問卷前有沒有修過安全衛生相關通識課程，有沒有興趣選修安全衛生通識課程之意願及理由等。

（2）對安全衛生課程議題之瞭解程度與學習興趣，此部分共列出 30 個安全衛生相關課程議題，如火災爆炸、呼吸防護、化學性危害、生物性危害等等，分別詢問學生的瞭解程度與學習興趣，並使用李克特(Likert)4 點式量尺（以 1 至 4 分計分，瞭解程度的選項為「非常不瞭解」、「不瞭解」、「瞭解」、「非常瞭解」對應給 1、2、3 及 4 分；而學習興趣的選項為「非常沒有興趣」、「沒有興趣」、「有興趣」、「非常有興趣」對應給 1、2、3 及 4 分）來計算瞭解程度與學習學習興趣，其中分數越高，表示有越高的學習興趣及瞭解程度。

2.13 資料分析

若問卷有資料填答不完整者視為漏失資料，不納入該項題目分析。此外，若填答者若為研究生，整份問卷亦不納入分析。資料分析前有三個項目分別再進行了進一步的歸納與計算。抽樣時所分的 16 學群在依據其屬性再歸納成生命與健康學群、理學學群、工程學群、人文學群與社會科學學群等五大學群，各學群的歸屬請參考表 2。

而有關學生對於 30 個安全衛生議題的學習興趣與了解程度部份則是將每個人對於其所勾選的 30 個議題的學習興趣進行平均值計算，再將所有回應者的學習興趣進行總平均，該平均值即為區分高低學習興趣的基準；了解程度也是採取相同的計算方式。

回收之問卷數據使用 SPSS 統計軟體進行描述性統計，呈現本次研究填答學生之基本特徵分佈情形，而基本特徵分布比例之統計則以卡方檢定分析之。而對於學生個人相關因素(如學系、年級、性別、以前有沒有修過安衛相關課程、對於安全衛生議題之學習興趣與了解程度等因素等)與修課意願間的關係則是用邏輯式回歸進行分析，而該邏輯式回歸模式的變項「對於安全衛生議題之學習興趣」與「對於安全衛生議題之了解程度」是以每位學生其 30 個議題之學習興趣平均值與了解程度平均值計算，並以四分位數做為不同程度組別的分組依據，此項分析則使用 SAS 統計軟體進行分析。所有分析之顯著意義機率均設定為 0.05。

2.2 研究結果

2.21 參與對象基本資料

本次調查共回收從 66 大學校院 239 個學系 4474 份問卷，所有研究對象的基本資料如表 4 所示。男女性別比例接近 1，年級分布則以二年級最多(33%)，一年級次之(28%)，三年級與四年級分別佔 22%與 17%。在學群分布方面有 53%比例學生來自生命與健康學群、理學與工學學群，47%則來自人文與社會科學學群。性別在不同學群中的分布並不一致(χ^2=456.742, df =4, $p < 0.001$)，這應該與男生偏好學習自然科學而女生偏好學習人文科學有關。

2.22 影響學生選修安全衛生通識課程意願的因素

表 5 的邏輯式回歸顯示學生的學群背景、過去有無選修過安全衛生相關課程與現在對安全衛生學習興趣高低是影響修課意願的顯著因子。與社會科學學群相比較，生命與健康學群、理學與工程學群有較高的修課意願(OR 分別為 1.68、1.42、1.69，$p<0.05$)。過去有過安全衛生修課經驗的學生對於此項安全衛生通識課程有較高的修課意願(OR = 2.40，$p<0.05$)，而對於安全衛生有較高學習興趣者也有較高的修課意願的發現也是可以被預期及理解的趨勢。

2.23 依學生學習興趣而建議的課程議題組合

依據所計算出學生對於30個安全衛生議題的學習興趣平均值，依學群不同進行了排序比較。發現每個學群有其各自學習偏好的議題，但所有學生學習興趣的總平均排名的前10項議題，包括緊急應變、火災爆炸、個人防護具、健康管理、急救、生物性危害、電腦危害預防、危害通識、呼吸防護、意外的分析與預防等，在不同學群中皆屬排序前端的共同性相當高。若同時考量所有學生所反映的對於30個安全衛生議題的學習興趣平均值及瞭解程度平均值，圖1的分類可作為課程設計組合上的參考。而最後建議教育部推動的通識課程議題為包含16個議題共32小時的方案，詳如表6所示。

2.3討論

藉由全面性抽樣調查以了解台灣大學生對於安全衛生通識課程的學習興趣，可發現不同科系背景的大學生對於安全衛生議題的學習興趣各有不同之處，但因通識課程的特性即是讓所有不同科系（安全衛生專業科系除外）的學生有機會一同學習安全衛生，故課程內容規劃力求兼顧專業與涵蓋最大多數學生的需求與期待。對大多數的大學生而言，有較高學習興趣的議題共同性很高，因此這部份的10 個議題（包括緊急應變、火災爆炸、個人防護具、健康管理、急救、生物性危害、電腦危害預防、危害通識、呼吸防護、意外的分析與預防）建議可優先考慮納入課程當中。其他不被學生所了解或學生學習興趣不高的議題，則建議選擇部分融入課程當中。除可減少學生因缺乏學習興趣而影響修課意願外，也提供機會讓學生認識那些可能因為不了解而不想學習的部份。

學生對於 30 個安全衛生議題所反應的興趣高低與了解程度若以整體平均值做為劃分，可以觀察到有 12 個議題是落在低興趣與低了解程度的區塊(圖 1 的 C 區)。這 12 個議題中有些議題可能因為看似與特定專業有關(如營建安全、機械安全、實驗室安全衛生法規等)而讓非該科系的學生覺得既不了解也沒有興趣去學習，但也可能因為某些議題的名稱過於專業(如游離輻射、非游離輻射等)，讓學生無從揣摩該議題的內容而導致缺乏興趣。因為問卷僅列出議題名稱而未有註解或說明，也未詢問原因，因此無法進一步判斷學生選擇的依據與原因。在兼顧學生的學習興趣與安全衛生的專業判斷下，建議形成的教材模組包括 16 個議題(請參閱表 6)共 32 小時，提供大學院校開課使用。但同時教育部也將所調查的 30 個議題均研發成每個議題 2 小時的教材，以供學校開課老師可以因應各自不同需求而使用。

而調查中發現有過安全衛生相關課程修課經驗者的比例很低(13%)，這與伍氏[52]於 2005 年針對南部 10 所大學的修課學生與對照組所調查的過去修課經驗比例(實驗組:14.4%; 對照組:16.9%)差異不大。而邏輯式回歸分析結果顯示有過修課經驗者對於繼續學習的意願比沒有修課經驗者顯著的高(OR=2.40, 95% C.I.=1.87-3.09)。此外，主修自然科學相關科系的學生表現了比主修人文社會相關科系有更高的學習興趣(表 5)，推測可能是因為台灣學校教育制度設計上讓高中就讀自然組學生因為實驗課、物理、化學、生物等科目的學習而比社會組學生更有機會接觸到安全衛生相關概念，因此，越早讓學生有機會接觸安全衛生，對於日後的相關學習會有正面幫助。

第三章 大學校院安全衛生通識課程內容評估

3.1研究方法

3.11 研究對象

安全衛生通識課程模組於2004年底建立，於2005年開始於各大專校院進行推廣開課。本項課程內容評估自2005年開始至2006年中邀請北部地區各大專校院選修安全衛生通識課程之學生參與，共有18所大學院校共933位學生參與本項評估研究。

3.12 研究架構與流程

課程內容可依據各校需求不同而挑選不同內容組合，故本項課程內容評估挑選各校共同性較高的13項議題進行評估。此13個議題分別為化學性危害、生物性危害、危害通識、噪音、游離輻射、非游離輻射、呼吸防護、個人防護具、人因工程、電腦作業危害預防、火災爆炸、電氣安全、急救。每個議題於每週課堂上講授2節(100分鐘)，故本項評估進行方式為開學第一周進行前測（Pretest），在學期最後一周進行後測（Posttest）。

3.13 問卷

評估問卷包括2個部份，第一部份為個人基本資料，包括姓名、學號、科系與年級。第二部份是用以評估13個議題的安全衛生知識的39題選擇題，每個議題有3題題目進行評估。題目來源為教育部發展安全衛生通識課程模組時同時發展建立的題庫，經由專家小組會議方式進行評估題目之挑選，根據題庫中的難易程度分類及考量問卷填答的時間長度(約20-25分鐘)，故決定採用每議題的3個題目共39題組成評估問卷。(問卷詳見附件2)

3.14 統計分析

本研究在認知分數的計算以答對給1，答錯給0，39題所得分數加總後再除以39即為個人的認知得分。單一議題的得分則是該議題的3題題目加總後除以3即為該議題的得分。使用成對樣本t檢定探討學生在課程前後其在安全衛生知識上的改

變。以獨立樣本T檢定探討不同學群與不同年級的學生在學習前其安全衛生知識上有無差異。使用線性回歸模式在控制年級別因素下分析不同學群是否影響學生的學習成效。所有分析皆使用統計軟體SPSS 12.0版進行資料分析且所有分析之顯著意義機率均設定為0.01。

3.2研究結果

3.21 研究對象基本資料

本項評估有來自 18 所北台灣大專校院共 933 位學生參與。表 7 顯示參與學生的基本描述性資料。整體而言，本次研究參與學生以 3 年級居多(43.0%)，1、2、4 年級的分布比例分別為 14.6%、22.4%與 20.0%。而自然科學學群與社會科學學群的比例差異很大，分別是 70.2%與 29.8%。學生的課前整體安全衛生認知程度，在不同年級間與不同學群間雖有不同但相近。若針對每一個議題個別分析不同學群的課前認知差異，表 8 的 t 檢定結果顯示僅 3 個議題在兩學群間有顯著差異，分別是「化學性危害」(0.77 vs. 0.70)、「危害通識」(0.57 vs.0.52)與「電氣安全」(0.82 vs.0.79)，且均是自然科學組高於社會科學組。

3.22 課程後安全衛生認知的改變

使用成對樣本 t 檢定分析學生在課前課後其安全衛生認知上的改變程度，其結果如表 8、9 所示。整體安全衛生認知有顯著的成長(得分由 0.60 提高到 0.67，$p<0.001$)，若針對每一個議題個別分析，除「電氣安全」外的所有議題均呈現顯著進步。若從不同年級來看，可以觀察到雖然每個年級也都是顯著進步，但進步程度隨著年級越高越明顯(後測得分依序 0.63, 0.64, 0.67, 0.72)。以不同學群而言，課後的得分可以觀察到自然科學學生(0.68)是比社會科學學生(0.65)要高的。

而使用線性回歸模式在控制年級別因素後分析不同學群是否在每一個安衛議題上的學習成效有所不同，結果如表 9 所示。雖然課前認知程度在 3 個議題(化學性危害、危害通識、電氣安全)上有所差異，但此 3 議題課後的進步程度卻沒有顯著差異。此外，全部 13 個議題中僅「人因工程」($\beta=0.047$, $p=0.002$)與「電腦作業危害預防」($\beta=0.049$, $p=0.004$)2 個議題在不同學群上有不同的學習成效，且同樣呈現自然科學組的進步程度高於社會科學組。

3.3 討論

課程內容評估需要實際開課的經驗回饋，由於不同學校對於課程包含內容有不同的選擇，故課程內容評估以最常被學校接受的 13 項議題(表 6) 為評估範圍，主要評估不同科系背景的學生是否都能在這項課程中達到最基本的安全衛生認知上的改變。933 位學生的參與，結果顯示整體課後的安全衛生認知比課前有顯著的進步(平均得分 0.6 提升到 0.67, $p<0.001$)。這結果與 1998 年 Lerman *et al.*(20), 2003 年 Wang *et al.*(21), 2005 年伍氏(52), 2009 年林氏(53)等人的研究結果一致。

與前述幾項研究不同的是本項內容評估針對所包含的 13 個議題分別進行分析，結果顯示除了「電氣危害」外，所有議題在課程後也都有顯著的進步。而電氣安全的不顯著進步可能導因於台灣的學生從小學就開始學習用電安全，因此該議題內容對於大學生而言可能過於簡單，從前測成績 0.82 即可看出。因此，此項議題是否保留(基於複習的觀點保留或者調整課程內容)或是以其他議題替代是未來課程更新與調整時需要進一步考量的。

針對不同學群的課前認知差異分析結果顯示兩組別在「化學性危害」、「危害通識」與「電氣危害」3 個議題上有顯著差異(自然組高於社會祖)，但在回歸分析中僅有「人因工程」和「電腦作業危害預防」2 個議題顯示了有學習成效上的差異(自然組高於社會祖)。推測可能是因為人因工程(電腦作業危害預防也是從人因工程角度出發探討的議題)是一項綜合工程學、生理學、解剖學、心理學等學科的應用學科，因此自然科學背景的學生比社會科學的學生更能掌握與吸收相關概念與資訊而有較佳的學習成效。但確實的影響因素仍需進一步的研究方能確定。

參與這項評估的 933 學生中有 70%是自然科學相關科系的學生，僅 30%屬於人文社會科系，這樣的選課學生比例印證了課程發展前的學習意願調查結果-主修自然科學相關科系的學生表現了比主修人文社會相關科系有更高的修課意願，而伍氏(52)研究中來自 10 所學校的實驗組自然科學相關科系比例(81%)遠高於社會科學相關科系(19%)的現象也同樣印證這個趨勢。而本項評估所顯示的自然科學組的學生不論是課前的認知程度或是學習後的成效都比社會科學組的學生略佳的現象

也與伍氏(52)的發現「醫、公共衛生學院與生命科學院的學生在安全衛生知識部份優於其它學院學生」相類似。顯見目前台灣大學生對於安全衛生的學習會因為科系背景的不同而有不一樣的學習動機與學習成效。

此部分的評估有一項研究限制是評估題目的篩選。前後測所用之問卷的 39 題題目係由專家學者研製的題庫而來，而該題庫並未針對所有題目進行題目難易度與鑑別度的實測分析，故題庫中對於題目的難易劃分均是由出題與審題的專家學者所判定。藉由此 933 位學生的前測結果進行題目分析，並參考一般選擇題型的題目鑑別度與難易度篩選標準後，以鑑別度>0.15，難易度 0.4-0.9 為篩選標準，結果共 25 題符合前述標準(鑑別度與難易度計算請參閱 4.13 節之說明)。

經由學生填答的結果所分析的題目難易度與出題專家學者所認定的難易有所不同。其中不一致的多屬於出題者認定為難度較高的題目但學生實測結果卻呈現難度較低的情況，這可能是因為過去沒有過大學生安全衛生認知普查的相關資訊可供參考，對於學生的知識背景並無從評估，僅能靠教學經驗的累積。因此，題目的實測分析對於完整題庫之建立與學習成效分析有著不可忽略的重要性。

使用 25 題的問卷資料分析結果詳如表 10-12 所示，由於有 4 個議題(化學性危害、危害通識、噪音、人因工程)題目變成 2 題，有 5 個議題(游離輻射、非游離輻射、個人防護具、電腦作業危害、電氣安全)僅剩 1 題，故這 9 個議題的得分結果與 39 題分析結果就有所不同。整體而言，前後測的變化趨勢沒有太大的差異，課後都有顯著的進步，僅 2 個議題呈現了不相同的結果。前後測的變化趨勢有了明顯改變的是游離輻射與非游離輻射(兩議題都刪除了難度過高的題目而只剩 1 題)，游離輻射僅有小幅度的進步(0.88 提高至 0.90)，而非游離輻射則呈現了退步(0.78 減少為 0.73)。由於這 2 個議題篩選後都僅剩 1 個題目，學生得分的變異程度大，其所呈現的結果代表性因而受到影響。故這部份的評估存在比較高的不確定性，需要進一步的確認。

25 題與 39 題的分析結果在自然科學組與社會科學組的課前認知差異情形上也

同樣沒有明顯差別，25 題分析結果相對於 39 題分析結果(化學性危害、危害通識、電氣安全)僅再多 1 個議題(噪音)有學群間的顯著差異。而利用線性回歸模式分析不同學群對於每個議題的學習成效是否有所差異的部份則並無不同，都是「人因工程」與「電腦作業危害預防」2 個議題呈現了學群間的顯著差異，且也都是自然科學組的進步程度高於社會科學組。

缺乏對照組則是課程內容評估工作的另一項研究限制，因為在推廣開課初期，是藉由各種管道邀請與說服台灣北部的大學校院開設課程與參與評估工作，要在同時間找到可資比較的對照組實在是太困難而無法執行。因此，只能選擇以研究對象的自我比較作為初步評估分析的方式。

雖然有 2 個議題(游離輻射與非游離輻射)的學習成效尚未能完全證實，但整體的安全衛生認知在課後有明顯提升且僅有 2 個議題(人因工程與電腦作業危害預防)的學習成效會因學生背景不同而有所差異，對於想達到所有學生都能有所收穫的基本目標算是達到了。也因此，此通識課程中較為成熟的議題內容是否還能進一步對學生在安全衛生的態度、自我效能與行為意向上有所影響則是下一步研究的方向。

第四章 大學校院安全衛生通識課程介入成效評估

4.1研究方法

4.11 研究對象

本研究立意選擇輔仁大學與實踐大學二校於96學年下學期所開設之安全衛生通識課程進行教學介入研究。以選修輔仁大學「職業安全衛生概論」（54人參與）及實踐大學「職業安全與衛生」（53人參與）通識課程學生為實驗組，再以選修輔仁大學「環境污染與健康」（49人參與）及實踐大學「氣候變遷與永續發展」（49人參與）通識課程學生為對照組。

4.12 研究架構與流程

由於學校情境，不可能為了教學實驗需要，以隨機分配來編班，故僅能就現有的教育情境，作最有效的控制(74)。因此，本研究採準實驗設計中的「不等的前測－後測控制組設計」，如圖2所示。而為評估此項教學介入的延續效果，除了實驗組與對照組於教學實驗介入前後分別進行「大專校院安全衛生認知與態度評量」之前測（Pretest）與後測（Posttest），以評估教學介入的立即效果外。此外，實驗組於教學介入完成後第4週（即間隔1個月）再進行一項延宕測（follow up test），以追蹤教學介入後的延續效果。本研究的教學介入評估範圍僅包括8個議題，即此安全衛生通識課程中的一半內容，每個議題於每週課堂上講授2節(100分鐘)，除了第1周(生物性危害)與第8周(危害通識)位了問卷施測而設定講授時間為70分鐘。此8個議題分別為化學性危害、生物性危害、危害通識、噪音、游離輻射、非游離輻射、呼吸防護、個人防護具(教案表如附件3)。實驗組的介入實施同時控制了以下因素：時間(同一周)、上課議題內容與先後順序(如圖2)及授課講師一致，以減少因課程內容不同及授課講師不同而導致介入之品質有所不同。

4.13 研究工具:問卷

本研究採用自編之「大專校院安全衛生認知與態度評量」問卷（附件 4）進行評估。問卷之編制係參考國內外相關文獻、課程教學目標及學者專家建議而成。問卷包含五個部份，第一部份為個人基本資料，主要針對學生之性別、科系、年

級、過去是否修過安全衛生相關課程、過去與現在是否有打工、打工類別、打工時是否有接受過安全衛生教育訓練、是否有在工作時受過傷、是否有親友曾經在工作場所意外受傷(包含職業疾病、傷害、殘廢或死亡)、是否有親友從事安全衛生相關工作(如勞工安全衛生管理員、師)、過去是否聽過安全衛生這個名詞等進行調查。第二部份是「大專校院安全衛生認知評估」，以四選一的選擇題方式進行安全衛生知識的評量。第三部分則是「大專校院安全衛生態度量表」，採李克特(Likert)五點式自量表方式進行設計，共包含四個面向：一般安全意識、特定安全意識、一般安全行為與特定安全行為，一般與特定的區分為特定安全意識與特定安全行為係針對介入課程內容所設計。每一個題目為一完整的敘述句，由填答者依其實際感受勾選最適當的選項。選項的五個尺度依序為「非常不同意」、「不同意」、「無意見」、「同意」、「非常同意」。第四部分是「安全衛生自我效能量表」，自我效能係指個體在特定情境中，對自己是否能成功地完成工作的能力知覺及判斷。因此這部份的設計為設想一些情境，詢問學生對於這些情境有多少程度的把握可以做到。同樣採李克特(Likert)五點式自量表方式進行設計，選項的五個尺度依序為「非常沒有把握」、「不太有把握」、「中立意見」、「有把握」、「非常有把握」。第五部分是「安全衛生行為意向量表」，行為意向是指反映個人對從事某行為的意願，因此這部份是預設 5 種情況，詢問學生未來進入職場後是否願意採取這些行為。選項採李克特(Likert)四點式自量表方式進行設計，選項的四個尺度依序為「一定不會」、「可能不會」、「可能會」、「一定會」。因為本項介入實施無法觀察到學生行為上有無改變，因此採用可能影響行為改變的「自我效能」與「行為意向」兩項來評估本介入課程是否在知識與態度外，也能對於行為的改變有所影響。

本問卷之效度與信度分析分別採用下列方式進行。

1、問卷效度：採用專家審查方式確認問卷效度（content validity）。本研究之自編問卷經初擬完成後，邀請包含安全衛生、教育和研究方法的5位專家學者提供修編意見，再修訂為正式問卷。

2、問卷信度：由於「大專校院安全衛生認知與態度評量」問卷有3種類型的題目，其中「大專校院安全衛生認知評估」為選擇題，而「大專校院安全衛生態度量表」、「安全衛生自我效能量表」、「安全衛生行為意向量表」

為量表，故需針對其不同的特性而進行不同的信度分析項目，分析項目說明如下；

（1）認知評估的題目：包括鑑別力分析與難度分析2項，題目依下列原則：「先選出鑑別率較高的題目，然後再從中選出難度指數適中的題目」進行題目之篩選。有關鑑別力分析與難度分析的進行方式分述如下：

A.鑑別力分析：鑑別力分析目的在於確定題目是否具有區分能力高低的作用，其計算公式如下：$D=P_H-P_L$，D：鑑別力指數，P_H：高分組答對百分比，P_L：低分組答對百分比。鑑別力指數通常介於-1.00到+1.00之間，指數越高表示鑑別度越大，如果指數為0表示該題目沒有鑑別度。如果低分組答對率高於高分組則表示該題目具有反向作用，應淘汰之。人數太少、試題不清或正確答案錯誤都可能導致此種情形。本研究採鑑別力指數達0.2以上為題目接受標準(39,50,75)。

B.難度分析：難度分析主要目的在確定每一個題目之難易程度，其計算方式如下：$P=(P_H+P_L)/2$，P：難度指數，P_H：高分組答對百分比，P_L：低分組答對百分比。難度指數以接近0.5的題目最為適宜，不過要找到所有題目P值都接近0.5有實際上的困難，故有學者建議以0.40~0.70為選擇題標準，也有學者建議以0.40~0.80為選擇題之標準，0.55~0.85為是非題之選擇標準(50)。由於本研究之「大專校院安全衛生認知測試」為選擇題型式，故以難度指數0.40~0.80為選擇標準。

（2）安全衛生態度、自我效能與行為意向量表：此部分量表的題目採用「內部一致性信度」(Cronbach α係數分析)進行題目篩選。而內部一致性係數要多大才表示可靠，根據Henson的觀點，認為這與研究目的與測驗分數的運用有關，如果研究目的在於編制預測問卷或測量某種構念之先導研究，信度係數在0.5至0.6已足夠。當以基礎研究為目的時，信度係數最好在0.8以上。當測驗分數是用來作為截斷分數之用而扮演重要角色，如篩選、分組、接受特殊教育等，則信度係數最好在0.9以上。如果以發展測量工具為目的，信度係數應在0.7以上。本研究以信度係數0.7作為接受標準(76)。

4.14 問卷預試結果

問卷預試之進行將選取與母群體特性相似的對象進行，故於96學年上學期徵求9校選修開設安全衛生通識課程之同學協助進行預試，共223人參與預試，預試結果共有23題認知評估題目符合篩選原則而納入問卷，而態度量表則是一般安全意識7題(Cronbach α=0.82)、特定安全意識13題(Cronbach α=0.83)、一般安全行為6題(Cronbach α=0,88)、特定安全行為11題(Cronbach α=0.83)；自我效能量表6題(Cronbach α=0.80)；行為意向量表5題(Cronbach α=0.78)。

4.15 統計分析

本項問卷第2部分有關安全衛生態度評量部份均以1、2、3、4及5分對應5點式量表的5個選項「非常不同意」、「不同意」、「無意見」、「同意」、「非常同意」，因此得分越高顯示填答者態度越正向。在自我效能部分則是以1、2、3、4及5分對應5點式量表的5個選項「非常沒有把握」、「不太有把握」、「中立意見」、「有把握」、「非常有把握」，因此得分越高顯示填答者對於一些安全衛生情境下的作為把握程度越高。而在行為意向部份則是以1、2、3、4分對應4點式量表的4個選項「一定不會」、「可能不會」、「可能會」、「一定會」，得分越高顯示填答者行為意向越正向。

本研究使用統計軟體SPSS與SAS進行資料分析，分析項目包括以卡方檢定探討實驗組與對照組基本組成之差異性、獨立樣本T檢定探討實驗組與對照組在學習前其安全衛生知識、態度、自我效能與行為意向的差異、成對樣本t檢定探討實驗組在介入後其在安全衛生知識、態度、自我效能與行為意向的立即改變與延續性改變上的差異性。此外，由於學習成效結果為同一位學生前後量測3次，數據間有相依性，故選用廣義估計方程式模式(Generalized Estimating Equation, GEE model)進行在控制學生個人因素(性別、科系背景、年級、打工經驗、打工的教育訓練經驗、是否有親友任職工安相關工作)等因素下介入之成效分析。所有分析之顯著意義機率設定為0.05。

4.2 研究結果

4.21 研究對象基本資料

本研究共有 106 位學生在介入組，98 位學生在對照組。因後測與延宕測的實施均在課堂上，因此施測時若有學生缺席就會損失該筆資料。後測共有 83 位學生在介入組，82 位在對照組。延宕測則是 73 位學生在介入組，73 位在對照組。表 13 顯示本次研究參與學生的基本描述性資料。不論是介入組或是對照組，男女的分布比例是接近的。整體而言，本次研究參與學生以二年級居多(47%)年級，4 年級次之(22%)，3 年級與 1 年級比例很接近(15%,16%)。但兩組間的年級分布並不一致($\chi^2 = 19.808$, df = 3, $p < 0.001$)。在有關過去是否有上過安全衛生相關課程部分，一如預期，僅很少的學生有過安衛相關課程修習經驗，且都在對照組，因此也呈現了兩組間的顯著差異($\chi^2 = 7.912$, df = 1, $p = 0.01$)。另一個在兩組間分布有所差異的項目是打工經驗($\chi^2 = 5.203$, df = 1, $p = 0.02$)，介入組有較高的比例有打工經驗。至於其他幾個項目，如：打工場所安衛訓練之有無、打工時受傷經驗之有無、是否有親友在工作時意外受傷、是否有親友從事安衛相關工作，課前是否聽說過安全衛生等都沒有顯著差異存在於介入組與對照組。

介入實施前實驗組與對照組不論是在安全衛生認知、態度、自我效能與行為意向上均無顯著差異。(表 14)

在介入組與對照組中有參加前測的學生，再依其有無參加後測分組分析，結果顯示兩組的未參加後測的學生與有參加後測的學生其課前的安全衛生認知、態度、自我效能與行為意向上亦無顯著差異。(表 15)

4.22 介入後安全衛生認知的改變

使用成對樣本 t 檢定分析兩組在介入前後安全衛生認知上的改變，其結果如表 16 所示。整體安全衛生認知上，介入組在介入後有顯著的成長(0.49 提升至 0.65)，並持續到介入結束後 1 個月(延宕測為 0.65)，而對照組雖在後測時顯示了進步(0.51 提升至 0.54)，但並未顯著且在延宕測時落回 0.52。若將安全衛生認知改變情況依介入課程內涵再細分成 8 個議題時，介入組有 5 個議題(化學性危害、危害通識、游離輻射、個人防護具及非游離輻射)在介入後顯示了立即的顯著進步，而 8 個議題在介入結束後一個月均呈現了顯著進步。其中，化學性危害的進步在介入結束

後持續成長但危害通識則呈現衰退的現象。在對照組的部份則僅在化學性危害的前測到延宕測出現了顯著的進步(0.26 提升至 0.36)，其他議題則沒有顯著的改變發生。

4.23 介入後安全衛生態度、自我效能與行為意向的改變

用成對樣本 t 檢定分析兩組在介入前後安全衛生態度、自我效能與行為意向上的改變，其結果如表 17 所示。介入組在介入後在一般安全行為、特定安全行為、自我效能與行為意向等項均有顯著的立即成長，且都持續到介入結束後 1 個月(即延宕測)，其中行為意向的成長在後測與延宕測期間仍是顯著(3.06 提升至 3.21，p=0. 04)。至於一般安全衛生意識與特定安全衛生意識雖有提升但對達顯著標準。而對照組僅一般安全行為與自我效能在後測時有顯著的進步(3.97 提升至 4.19; 3.57 提升至 3.78)，其他項目在不同時間點都未有明顯的改變。

4.24 介入成效分析結果

使用廣義估計方程式模式(GEE model)分析在控制了學生的個人因素後(如性別、年級、學院別、打工經驗、打工場所安衛訓練之有無、是否有親友從事安衛相關工作等)分析在成對樣本 t 檢定有顯著進步的 5 個變項(包含認知、一般安全行為、特定安全行為、自我效能與行為意向)。分析結果如表 18 所示。介入組相對於對照組在控制其它變項下在安衛認知與態度的特定安全行為兩項上呈現了顯著提升效果。而除了介入本身外，重複的問卷施測對於安衛認知、態度(一般安全行為與特定安全行為)、自我效能與行為意向的提升也有顯著的正向貢獻。

在 GEE model 中新增一個相乘變項(介入組別*問卷重複施測)再次分析，其結果如表 19 與圖 3~4 所示。在安衛認知、態度(特定安全行為)、自我效能與行為意向等項目中，此相乘變項均有統計上的顯著意義。

4.3 討論

由介入研究的結果可發現由 8 項議題所組成的介入課程對於修課學生的安全衛生知識造成了顯著且持續的進步，這與前述課程內容評估結果及其他以學校課程為研究對象的相關研究[20-21,52-53]結果是一致。在安全衛生態度與行為意向上也產

生正向且持續的改變，這與 1998 年 Lerman *et al.*(20), 2003 年 Wang *et al.*(21)與 2005 年伍氏(52)等人的研究結果一致。這樣的學習成效或許可以歸因於課程內容的設計，因為希望安全衛生可以成為生活中的一部份而不是艱澀難懂的專業，且考量修習這樣通識課程的學生可能都缺乏職場實際經驗，因此課程內容的設計著重在與日常生活環境的連結，希望藉此引起學生學習的興趣與增進學習的成效。這樣的推論或許可以從介入組在「化學性危害」與「危害通識」2 個議題的學習表現獲得佐證。介入組的化學性危害學習成效持續提升(0.30 ->0.49 ->0.57)，可能與生活中到處都有化學品而讓學生容易感受其重要性而願意學習。而「危害通識」的內容包含大量的記憶且主要應用在職場環境，與日常生活的關連性較低，因此短時間內的進步明顯(0.54 提升至 0.78)，但其延宕測結果就無法維持後測的得分水準(0.78 提升至 0.67)。而林氏(53)所進行的關於學生對於課程中較有興趣的主題的質性訪談也有相類似的發現，學生對於與自身的生活有實質關聯的主題，如急救、輻射、食品安全等較有興趣。

本項介入課程所包含的 8 個議題分別代表大學生 4 種不同的學習興趣與了解程度(分類請參考圖 1)。高學習興趣與高了解程度：個人防護具、危害通識、呼吸防護、化學性危害等 4 議題。高學習興趣但低了解程度：生物性危害屬之。低學習興趣但高了解程度：噪音屬之。低學習興趣且低了解程度：游離輻射與非游離輻射屬之。從介入組進步程度來看，除了呼吸防護和生物性危害兩者在一開始的進步未達顯著外，有高學習興趣的議題都顯示顯著與持續的進步。而屬於低學習興趣的噪音的一開始的未顯著進步即可能導因於學生的學習興趣不高。而屬於學習興趣與了解程度均低的游離輻射與非游離輻射，雖然在課程內容評估時未能獲得確實顯著進步的證據，但在此介入研究中此 2 議題一開始就顯著進步並持續到研究結束。因此，除了確定這 2 個議題確實可以有效提升學生的認知程度外，也印證第一部分調查學習意願時的低學習興趣可能導因於學生不了解所謂游離輻射與非游離輻射這 2 個專業名詞背後的內涵。一旦接觸後了解這樣的課題與自身生活的關連性，學習的進步就會很明顯，此項推論也可由林氏(53)所進行的質性訪談中獲得支持。就此而言，當初規劃課程內容時以學生已有高度興趣的議題加上部分重要但學生沒有興趣的議題進行設計的方向是恰當的。因為很多的缺乏興趣可能多導因於不了解，而這門通識課程成為了一座橋樑，開啟學生第一次的接觸，

也協助奠定或引發日後繼續學習的基礎。

在安衛態度中一般安全意識與特定安全意識在介入後雖有提升(4.09 升高至 4.17; 3.99 升高至 4.05)，但未達顯著。可能的原因之一是相對於一般安全行為與特定安全行為而言，此兩項的前測分數偏高(滿分為 5)，較無大幅成長的空間。另一個可能因素是問卷題目內容的偏重不同，安全行為的題目因考量到課程中講授到個人可以運用的工作多是偏向個人防護具的正確選用與佩帶，因此題目的設計較偏向個人防護具為主，與安全意識的題目涵蓋層面較廣的特質有所不同，因此呈現出不一樣的學習後成效。

關於行為意向的提升趨勢與認知、態度、自我效能相比有些不同(延宕測時較後測更為顯著提升)，可能的原因是一般學習的順序上，認知的改變通常最先發生，態度次之，再來才是行為的改變，所以可能因此在時間上有一些落差。再者介入組所選修的通識課程於後測結束後仍在持續進行，即使討論的議題不同，但仍屬於安全衛生的範疇內，對於學生而言仍是關於安全衛生相關的刺激，因此可算是另一種形式的介入。而此項另種介入對於認知、態度、自我效能與行為意向而言，對行為意向的影響最為明顯(僅行為意向之後測與延宕測差異達到顯著)，因此，究竟是哪些因素影響行為意向的改變仍需更進一步的研究方能釐清。

此外，由 GEE model 分析的結果發現除了介入外，「重覆填寫問卷」對於學生在安衛認知、態度、自我效能與行為意向上均有正面的影響。由於問卷填寫本身也可被視為是一種資訊提供的方式，因此重複的填寫也是一種訊息刺激。這項結果或許可以對於「再教育(refreshment learning)對於提升學習成效的重要性」提供一項正面支持。

本項介入成效評估的兩項限制是:後測與延宕測的間距不夠長與行為改變之評估。一般分析學習成效，除了立即性的影響外(後測與前測的差異)，也關注該項影響能否持續，這就是延宕測的主要目的。而本項介入研究的延宕測設定在 8 項議題都結束後 1 個月進行主要考量到時間因素，因為通識課程選修學生來自不同科系、不同年級的學生，在學期課程結束後要再追蹤的難度相當高。因此選擇在接

近學期結束前進行延宕測，希望至少能觀察到一些長期效應的初步證據。

行為是否有所改變必須先明確定義出被觀察的行為以及可以觀察到行為發生的機會，暫不論在此一涵蓋日常生活與職場環境的安全衛生課程中定義出明確行為有相當的難度，在以演講為授課方式的課堂上幾無機會觀察到學生行為是否有所不同，故僅能以行為意向的問題間接了解學生在行為方面的可能改變情形。

第五章 結論與建議

於大學通識課程系統中開設安全衛生相關課程是一個新的嘗試，為瞭解此安全衛生通識課程應具備的內涵與評估課程推行後之學習成效，本研究依序進行課程發展前的調查、課程發展中的內容評估到課程發展成熟後的介入成效評估。

調查提供了課程規劃的建議方向，並在課程內容評估部分獲得初步可有效提升學生安全衛生認知的證實。而針對課程模組中的 8 個較為成熟議題進行認知、態度、自我效能與行為意向的介入成效評估時，亦獲得正面的結果。因此推論學生可藉修習這門課程協助其當生活中遭遇相關問題時，可採行合適的應對措施，建立健康安全的生活態度。

本研究的內容並未包含安全衛生通識課程中所有議題，故未來仍需投入更多的研究探討其他議題之介入成效，在獲得足夠的實證資訊下方能對整體課程內容之修正研議出恰當的方向與架構。此外，現有各議題的課程內容主要著墨於各類危害的基本認知與入門的預防措施；知識的傳遞仍是本課程的核心，希冀學生因為明白危害的存在而採取專業建議的因應行為。但是知識的改變與真實行為的發生間的距離是否有因此而縮短是目前研究無法回答的問題。這部份需要藉助安全衛生與教育(或行為科學)等不同專業間的共同合作研究，方能有更清晰的答案。

以本研究所獲得的資訊可總結出使安全衛生知識與日常生活產生明顯連結是提升學生學習興趣的首先要件。此外，過多的科學理論解釋也可能讓缺乏自然科學知識背景的學生因挫折感而失去興趣，因此課程中使用生活中的實例進行解釋也有助於減低這樣的挫折感。關於整個學期的課程議題的排定也建議採用於數個較易引發學生學習興趣的議題後加入一個重要但學生可能較不易了解的議題，然後再繼續幾個學生有興趣的議題，這樣的順序安排可以略微減輕學生可能因接連幾次覺得困難(或無趣)而失去對課程後續學習的意願，這樣的建議源自個人於研究後期 3、4 年間也同時擔任通識課程講師的授課經驗與感受。現今台灣的大學通識課程規劃對大學生而言，常有一種因規定不得不選修的氛圍，除非課程內容有趣、吸引人，否則學生多以輕鬆(忽)的態度面對通識課程。因此，欲讓學生願意聽進老師所講授課程內容，引起興趣是必要條件。

但有些在職場上面臨的情況與日常生活情境可能不一致，常無法在有限的授課時間內一一詳細舉例說明，這是其他授課講師面臨的取捨難題。建議日後課程可以思考發展為兩類:「生活中的安全衛生」與「職業安全衛生」。「生活中的安全衛生」著重於日常生活中的情景，為初階課程，必須有此基礎後方能再選修進階課程「職業安全衛生」，而「職業安全衛生」就可以完全針對各式職場的情形加以說明介紹。由於通識課程的學生來自不同科系與不同年級，學生想要瞭解的焦點也有所不同(日常生活 vs. 職場環境)，因此，將課程再做分類或許是未來值得嘗試的方向。此外，在本研究第一部分的調查即發現「過去有安全衛生相關學習經驗」會正向提昇進一步的學習動機，因此在校園中讓學生有此項學習經驗對於他們將來進入職場後可能面臨的相關安全衛生教育訓練而言也許會有所助益。

一項課程的成功不僅需好的教案，合適的師資也是不可缺的。阿拉斯加州於 1992 年開始推行的工作危害認知計畫暫停的原因之一就是師資缺乏。因此，教育部在 93 年開始推廣安全衛生通識課程時就同時進行另一項師資培育計畫(民國 93-97 年)，由安全衛生相關研究所之博士生加以培訓而成，以因應各學校開設課程時面臨的師資缺乏問題。因為安全衛生通識課程是由多項議題組合而成，師資的支援也以議題作為規劃的依據，因此開課老師可以無後顧之憂的視學生需求彈性規劃課程內容的議題組合，進而發展出風貌各有不同的課程。一門課程有多位老師共同授課是大學中常見的課程安排，讓學生可以跟隨各有專精的老師學習。但若缺乏一位整合一整門課程的老師，也可能讓學生的學習變得零散。在個人擔任安全衛生支援師資過程中觀察到安全衛生通識課程存有這樣的隱憂，因為很難有一位老師可以專精所有的安全衛生議題，因此多人共同授課是較恰當的安排。但學生在通識課程中的積極學習的意願通常較專業科目為弱，因此，一位貫穿整學期課程的負責老師對於協助學生整合所學就有其重要性。而在課程推廣數年後的現在，當教育部的師資支援於 98 學年開始不再繼續辦理或相關補助經費逐漸縮減時，這樣的改變是否會衝擊到已逐漸開展的安全衛生通識課程之開課情形或是教學品質，有待觀察。對整個推動安全衛生通識課程的政策而言，這是值得進一步了解與評估。

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27.邱淳敏(2008)，台北地區公立高職汽車科學生實習工廠安全衛生滿意度研究，國立台灣師範大學工業教育學系碩士論文。
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29.吳善得(2008)，台北市立高級工業職業學校機械科實習工場安全衛生滿意度之研究，國立台灣師範大學工業教育學系碩士論文。

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31.王坤楠(2002)，高職工科教師工業安全衛生態度之研究，國立台北科技大學技術與職業教育研究所碩士論文。

32.劉釋霞(2006)，高職餐飲類科學生對實習場所危害風險知覺之研究，南台科技大學技職教育與人力資源發展研究所碩士論文。

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35.李欣烜(2008)，高職重機科實習課程安全衛生之研究，國立台灣師範大學工業教育學系碩士論文。

36.張天民(2008)，我國高職學校工業類科群教師對「實習(驗)場所急救知能」之研究，國立台灣師範大學工業教育學系碩士論文。

37.蔡政鴻(2005)，高職電機科學生電氣安全認知與電氣安全行為之研究，國立彰化師範大學工業教育與技術學系碩士論文。

38.莊坤祥(2008)，高中學生化學實驗室危害風險知覺對其安全行為影響之探討-以安全態度為中介變項，南台科技大學技職教育與人力資源發展研究所碩士論文。

39.黃舉富(2005)，台北縣市高級職業學校機械科工場安全衛生教育成效之研究，國立臺灣師範大學工業教育學系碩士論文。

40.劉亮言（2005），台灣北區高級工業職業學校木工實習工場安全衛生教育訓練之探討，國立臺灣師範大學工業教育學系碩士論文。

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43.劉亭君(2005)，大專院校校園環安衛改善計畫之成效分析，國立中央大學環境工程研究所在職專班碩士論文。

44.邱創煥(2006)，以某綜合大學普通化學實驗化學藥品使用現況之調查與分析，中國文化大

勞動學研究所碩士論文。
45.江美瑩(2007)，大學校園環安位議題研擬 EMS 與 OHSAS 之結合應用，國立台北大學自然資源與環境管理研究所在職專班碩士論文。
46.杜要嫥(2002)，我國大專院校學生意外災害與安全衛生認知調查，國立成功大學醫學院環境醫學研究所碩士論文。
47.郭耀煌(2006)，研究生對實驗室危害之認知行為研究-以某大專院校為例，國立交通大學工學院產業安全與防災學程碩士論文。
48.林芳貞（2005），危險物及有害物通識標示認知度之研究-以五所大專院校為例，中國文化大學勞動學研究所碩士論文。
49.沈志磬(2008)，科技大學應屆畢業生對工作場所的安全衛生知識與態度之研究-以南台科技大學為例，南台科技大學技職教育與人力資源發展研究所碩士論文。
50.李金泉(2001)，非同步式網路輔助教學之研究—以技職校院工業安全課程為例，國立彰化師範大學工業教育學系博士論文。
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52.伍純瑩(2005)，大專院校學生安全衛生教育評量成效與認知態度之研究-以南部大專院校為例，高雄醫學大學職業安全衛生研究所碩士論文。
53.林慧敏(2009)，一所教育大學實施環境安全與衛生防護課程成效之研究，國立台北教育大學自然科學教育學系碩士論文。
54.陳志傑(2000)，實驗室安全衛生教育訓練推廣規劃計畫，教育部環境保護小組。
55.李樹華, 方鴻源(2001)，環安衛實務概論教案設計計畫，教育部環境保護小組。
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knowledge and attitudes regarding pain management in hospitalized patients. *Pain Manag Nurs.* 2001; 2(2):47-53.

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on classmates of injured children: a prospective clinical trial. *Journal of Trauma Nursing* 2006; 13(3): 96-101.

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表 1. 2000-2009 年國內與學校安全衛生有關碩博士論文一覽表

學校	屬性		題目	研究生	年份
高職	現況調查	管理相關	職業學校實習工廠安全性之調查研究	黃嘉男	2003
			高職工業類科學生對實習場所安全衛生經營績效之研究	王振鴻	2006
			台北市高級工業職業學校汽車科實習工場安全衛生滿意度之研究	江瑞卿	2007
			我國高級工業職業學校安全衛生管理模式建置之研究	許錫銘	2008
			台北地區公立高職汽車科學生實習工廠安全衛生滿意度研究	邱淳敏	2008
			台北市立高級工業職業學校機械科實習工場安全衛生滿意度之研究	吳善得	2008
		認知態度相關	高職工科學生防火安全認知與態度之研究	韋龍方	2000
			高雄市高職學生對勞工安全衛生認知程度之研究	柯煒煜	2002
			高職工科教師工業安全衛生態度之研究	王坤楠	2002
			高職餐飲類科學生對實習場所危害風險知覺之研究	劉釋霞	2006
			高中(職)化學實驗室安全衛生管理現況及管理人員之知識、態度與行為研究	洪金柳	2007
			高職餐飲管理科師生實習工廠安全衛生態度之研究-以基北區為例	丁秀娥	2008
			高職重機科實習課程安全衛生之研究	李欣烜	2008
			我國高職學校工業類科群教師對「實習(驗)場所急救知能」之研究	張天民	2008
	其他		高職電機科學生電氣安全認知與電氣安全行為之研究	蔡政鴻	2005
			高中學生化學實驗室危害風險知覺對其安全行為影響之探討-以安全態	莊坤祥	2008

			度為中介變項		
	教育與課程		台北縣市高級職業學校機械科工場安全衛生教育成效之研究	黃舉富	2005
			台灣北區高級工業職業學校木工實習工場安全衛生教育訓練之探討	劉亮言	2005
			高職海事群實習課程安全衛生教育能力指標之研究	過子凡	2005
大學	現況調查	管理相關	我國技專校院實驗場所安全衛生管理現況之調查	江義清	2002
			大專院校校園環安衛改善計畫之成效分析	劉亭君	2005
			以某綜合大學普通化學實驗化學藥品使用現況之調查與分析	邱創煥	2006
			大學校園環安位議題研擬 EMS 與 OHSAS 之結合應用	江美瑩	2007
		認知態度相關	我國大專院校學生意外災害與安全衛生認知調查	杜要嫥	2002
			研究生對實驗室危害之認知行為研究-以某大專院校為例	郭耀煌	2006
			五所大專院校學生危險物及有害物通識標示認知度之研究	林芳貞	2006
			科技大學應屆畢業生對工作場所的安全衛生知識與態度之研究-以南台科技大學為例	沈志磬	2008
	教育與課程		非同步式網路輔助教學之研究—以技職校院工業安全課程為例	李金泉	2001
			環境與安衛通識課程教案評估研究	張文龍	2001
			大專院校學生安全衛生教育評量成效與認知態度之研究-以南部大專院校為例	伍純瑩	2006
			一所教育大學實施環境安全與衛生防護課程成效之研究	林慧敏	2009

表 2.職場安全衛生教育訓練相關文獻整理

年份	第一作者	研究主題/對象	研究方法	結果
2000	Tan-Wilhelm	Impact of a worker notification program / worker in beryllium machining plant	1.Self-report attitudinal and behavioral response 2.Case and control study 3.Pretest, posttest and one month follow-up test	Worker receiving notification reported significantly stronger perceptions of threat and efficacy, more positive attitudes toward safety practices, and engaged in more protective behaviors than the workers at the control plant.
2000	Arnetz	Implementation and evaluation of a practical intervention programme / health care workers	1.Self-report violence incidents for one year 2.Case and control study 3.Pretest and posttest	Staff at the intervention work sites reported 50%more violent incidents than the control work site during the year. Compared to the control group, intervention group staff reported better awareness: of risk situation for violence; of how potentially dangerous situations could be avoided; and of how to deal with aggressive patients.
2001	Erkes	Determine the effectiveness of an educational intervention focused on pain management / medical (surgical) intensive care nurses	1.To measure knowledge and attitude level regarding pain control 2.No control study 3.Pretest and posttest	A significant increase in scores after the educational intervention (t=9.6, p=0.0005).additionally, a statistically significant correlation was found between change score (posttest minus pretest scores) and years of nursing experience.
2002	Derebery	Evaluation of the impact of educational intervention on physicians' management behaviors of low back pain / physicians	1.To measure low back pain patients' outcomes 2. Case and control study 3.one year collection for physician's treatment outcomes before training and 10 month collection after training	The intervention group reduced the percentage of restricted work cases, reduced the percentage of lost-time cases for male patients and female patients (less than 40 years old), and shortened restricted workday duration and total case duration for female patients.
2004	Becker	Impacts of Health and safety education / hazardous waste and chemical emergency response program	1.Self-report questionnaire 2.No control study 3.Pretest and posttest	The study population showed an increase in training of other workers, use of resources, attempts at improvements, success rates for those attempting change, and overall success at making improvements.

2004	Shah	Evaluation of the training Workshops / Washington state ergonomics rule	1.Self-report questionnaire 2.No control study 3.Pretest and posttest	Participants' knowledge of the ergonomics rule and hazard reduction methods increased significantly. Those with no previous ergonomics training had a greater increase in their knowledge than those who had some ergonomics training in the past.
2005	Harivigsen	To evaluate the effectiveness of an education and low tech ergonomic intervention / home care nurses	1.Self-report questionnaire (the Standardized Nordic Questionnaire) 2.Case and control study 3.Pretest and posttest	No significant differences were found between the two groups for any of the LBP variables, and both groups thought that education in patient transfer techniques had been helpful.
2006	Badii	Evaluation of a workplace-based program to reduce occupational musculoskeletal injury / healthcare worker	1.Case and control study 2.Three years of historical data and 1 year of data collected prospectively during the intervention year	The finding that MSI-associated time-loss and compensation costs were significantly lower during the program illustrates the effectiveness of this program and demonstrates that increased reporting of MSIs need not be associated with increased claims costs.

表 3. 抽樣學群與學系統計表

原 16 學群	總校數	學系總量	樣本數(系)	五大學群*
地球科學	14	10	9	B
教育	33	42	17	D
法律	21	16	12	F
生命科學	33	21	14	A
工程	57	155	18	C
醫藥衛生	21	28	15	A
農林漁牧	11	35	16	A
體育休閒	17	10	9	A
大眾傳播	13	15	12	F
商管	64	148	18	F
人文	60	120	18	D
資訊（含電機）	47	64	18	C
社會科學	36	56	18	F
建築與設計	22	21	14	C
數理化	34	70	18	B
藝術	27	19	13	D
合計		776	239	

* A: 生命與健康學群、 B: 理學學群、 C: 工程學群、、 D: 人文學群、 F: 社會科學學群

表 4. 「大學生對安全衛生通識課程學習意願調查」之人口統計學資料

	生命與健康學群 n (%)	理學學群 n (%)	工程學群 n (%)	人文學群 n (%)	社會科學學群 n (%)	總計 n (%)
性別						
男	508 (43)	276 (67)	690 (76)	281 (32)	447 (42)	2202 (50)
女	669 (57)	138 (33)	217 (24)	594 (68)	628 (58)	2246 (50)
年級						
1	394 (33)	65 (16)	197 (22)	270 (31)	287 (28)	1213 (28)
2	295 (25)	150 (37)	346 (39)	330 (38)	337 (32)	1458 (33)
3	239 (20)	140 (34)	195 (22)	127 (15)	272 (26)	973 (22)
4	252 (22)	55 (13)	155 (17)	147 (16)	145 (14)	754 (17)
學校類別						
一般大學	807 (68)	384 (92)	501 (55)	659 (75)	795 (74)	3146 (70)
技職大學	377 (32)	31 (8)	414 (45)	221 (25)	285 (26)	1328 (30)
是否有安全衛生相關課程修課經驗						
有	184 (16)	58 (14)	125 (14)	116 (13)	96 (9)	579 (13)
沒有	983 (84)	353 (86)	774 (86)	753 (87)	976 (91)	3839 (87)

表 5. 影響大學生選修安全衛生通識課程意願的因素

因素	Adjusted Odds Ratio # (95% CI)
年級	
1	1.00
2	0.83 (0.67-1.04)
3	0.78 (0.64-1.00)
4	0.89 (0.69-1.16)
性別	
男	1.00
女	1.11 (0.93-1.33)
學校類別	
一般大學	1.00
技職大學	1.04 (0.86-1.27)
過去安全衛生相關修課經驗	
沒有	1.000
有	2.40 (1.87-3.09) A
學群	
社會科學學群	1.00
人文學群	1.15 (0.88-1.50)
工程學群	1.69 (1.28-2.22) A
理學學群	1.42 (1.02-1.98) A
生命與健康學群	1.68 (1.31-2.14) A
對 30 個議題的學習興趣	
第一四分位數	1.00
第二四分位數	2.83 (2.23-3.58) A
第三四分位數	9.01 (7.09-11.46) A
第四四分位數	22.11 (16.07-30.43) A
對 30 個議題的了解程度	
第一四分位數	1.00
第二四分位數	1.16 (0.93-1.46)
第三四分位數	1.25 (0.99-1.58)
第四四分位數	0.89 (0.66-1.20)

A $p < 0.05$

Adjusted for all variables in the table

表6. 教育部安全衛生通識課程模組

16項議題	課程內容評估的13項議題
實驗室安全衛生概論	
化學性危害	化學性危害
危害通識	危害通識
生物性危害	生物性危害
噪音	噪音
游離輻射	游離輻射
非游離輻射	非游離輻射
個人防護具	個人防護具
呼吸防護	呼吸防護
人因工程	人因工程
電腦作業危害	電腦作業危害
火災爆炸	火災爆炸
電氣安全	電氣安全
急救	急救
實驗室廢棄物	
機械安全	

表 7. 課程內容評估研究參與者之年級與學群分布(39 題)

	N (%)	Mean Score (Mean ± SD) Pretest	Posttest	Paired-t	*p*–Value
	933(100%)	0.60±0.10	0.67±0.12	18.831	<0.001*
年級					
1	136 (14.6)	0.59±0.11	0.63±0.13	3.763	<0.001*
2	209 (22.4)	0.58±0.10	0.64±0.11	7.577	<0.001*
3	401 (43.0)	0.60±0.09	0.67±0.12	12.576	<0.001*
4	187 (20.0)	0.62±0.09	0.72±0.12	12.844	<0.001*
學群					
自然組	653 (70.2)	0.60±0.10	0.68±0.12	17.113	<0.001*
社會組	277 (29.8)	0.59±0.09	0.65±0.13	8.350	<0.001*

* $p<0.01$

表 8. 課程內容評估 13 項議題之前後測分數 (n=933, 39 題)

議題	Mean Sub–Score (Mean ±SD) Pretest	Posttest	Paired-t	*p*–Value
化學性危害	0.75±0.25	0.80±0.25	6.042	<0.001*
危害通識	0.56±0.25	0.64±0.25	8.103	<0.001*
生物性危害	0.77±0.25	0.82±0.26	5.301	<0.001*
噪音	0.59±0.26	0.64±0.27	5.395	<0.001*
游離輻射	0.35±0.17	0.49±0.26	15.619	<0.001*
非游離輻射	0.38±0.25	0.47±0.28	7.544	<0.001*
個人防護具	0.65±0.24	0.70±0.21	5.535	<0.001*
呼吸防護	0.57±0.29	0.67±0.30	8.276	<0.001*
人因工程	0.77±0.23	0.85±0.21	8.626	<0.001*
電腦作業危害	0.30±0.24	0.37±0.24	7.828	<0.001*
火災爆炸	0.56±0.30	0.65±0.30	5.140	<0.001*
電氣安全	0.82±0.21	0.82±0.21	0.603	0.55
急救	0.56±0.30	0.65±0.30	8.030	<0.001*

* $p<0.01$

表 9. 不同學群背景學生的前測分數 T 檢定結果與進步程度回歸分析結果(n=930, 39 題)

議題	學群	Pretest T–Test (t, *p*-Value)	Posttest	Paired-t	*p*–Value	Regression [A] β± SE	*p*–Value
化學性危害	自然組	0.77±0.24	0.81±0.23	4.64	<0.001*	0.019±0.015	0.207
	社會組	0.70±0.24 (t=3.92, p<0.001*)	0.76±0.25	3.89	<0.001*	-	
危害通識	自然組	0.57±0.25	0.65±0.25	6.46	<0.001*	0.032±0.018	0.074
	社會組	0.52±0.24 (t=2.96, *p*=0.003*)	0.61±0.25	4.83	<0.001*	-	
生物性危害	自然組	0.77±0.26	0.82±0.22	4.66	<0.001*	0.012±0.016	0.436
	社會組	0.76±0.24 (t=0.29, *p*=0.770)	0.81±0.24	2.49	0.013*	-	
噪音	自然組	0.60±0.26	0.64±0.25	4.10	<0.001*	0.008±0.017	0.617
	社會組	0.56±0.26 (t=2.03, *p*=0.042)	0.62±0.27	3.41	0.001*	-	
游離輻射	自然組	0.35±0.18	0.49±0.27	13.11	<0.001*	0.013±0.018	0.493
	社會組	0.34±0.15 (t=0.64, *p*=0.521)	0.47±0.25	8.46	<0.001*	-	
非游離輻射	自然組	0.39±0.26	0.48±0.29	7.11	<0.001*	0.045±0.020	0.023
	社會組	0.38±0.23 (t=0.51, *p*=0.614)	0.43±0.27	2.90	0.004*	-	
個人防護具	自然組	0.65±0.24	0.71±0.22	5.31	<0.001*	0.025±0.015	0.113
	社會組	0.66±0.23 (t=-0.50, *p*=0.620)	0.69±0.22	1.79	0.075	-	
呼吸防護	自然組	0.57±0.29	0.66±0.30	6.63	<0.001*	0.001±0.020	0.946
	社會組	0.56±0.28 (t=0.75, *p*=0.451)	0.66±0.29	4.90	<0.001*	-	
人	自然組	0.77±0.23	0.86±0.20	8.49	<0.001*	0.047±0.015	0.002*

因工程	社會組	0.76±0.23 (t=0.71, *p*=0.478)	0.82±0.24	2.96	0.003*	-	
電腦作業危害	自然組	0.30±0.24	0.40±0.24	7.68	<0.001*	0.049±0.017	0.004*
	社會組	0.30±0.24 (t=-0.25, *p*=0.805)	0.34±0.24	2.25	0.025*	-	
火災爆炸	自然組	0.74±0.24	0.79±0.23	4.56	<0.001*	0.036±0.017	0.033
	社會組	0.71±0.24 (t=1.59, *p*=0.112)	0.75±0.24	2.36	0.019*	-	
電氣安全	自然組	0.83±0.20	0.83±0.21	-0.05	0.96	0.017±0.014	0.235
	社會組	0.79±0.21 (t=3.15, *p*=0.002*)	0.80±0.21	1.14	0.25	-	
急救	自然組	0.55±0.30	0.64±0.30	6.57	<0.001*	-0.027±0.021	0.196
	社會組	0.58±0.30 (t=-1.41, *p*=0.158)	0.67±0.30	4.44	<0.001*	-	

* $p < 0.01$

[A]: 回歸模式共控制下列 2 變項:年級、前測成績

表 10. 課程內容評估研究參與者之年級與學群分布(25 題)

		Mean Score (Mean ± SD)			
	N (%)	Pretest	Posttest	Paired-t	*p*–Value
	933(100%)	0.67±0.13	0.74±0.15	16.074	<0.001*
年級					
1	136 (14.6)	0.65±0.15	0.70±0.16	3.116	0.002*
2	209 (22.4)	0.65±0.13	0.71±0.14	6.528	<0.001*
3	401 (43.0)	0.67±0.13	0.75±0.14	11.596	<0.001*
4	187 (20.0)	0.71±0.13	0.80±0.13	11.409	<0.001*
學群					
自然組	653 (70.2)	0.68±0.13	0.75±0.14	13.733	<0.001*
社會組	277 (29.8)	0.65±0.12	0.72±0.15	8.215	<0.001*

* $p<0.01$

表 11. 課程內容評估 13 項議題之前後測分數 (n=933, 25 題)

議題(題目數)	Mean Sub–Score (Mean ±SD) Pretest	Posttest	Paired-t	*p*–Value
化學性危害(2)	0.64±0.33	0.71±0.33	6.007	<0.001*
危害通識(2)	0.70±0.32	0.78±0.30	7.008	<0.001*
生物性危害(3)	0.77±0.25	0.82±0.26	5.301	<0.001*
噪音(2)	0.75±0.30	0.81±0.28	5.553	<0.001*
游離輻射(1)	0.88±0.32	0.90±0.30	1.415	0.16
非游離輻射(1)	0.78±0.52	0.73±0.44	-2.864	0.004*
個人防護具(1)	0.65±0.48	0.81±0.39	9.092	<0.001*
呼吸防護(3)	0.57±0.29	0.67±0.30	8.276	<0.001*
人因工程(2)	0.66±0.33	0.79±0.31	8.819	<0.001*
電腦作業危害(1)	0.52±0.50	0.71±0.45	10.169	<0.001*
火災爆炸(3)	0.73±0.24	0.78±0.23	5.140	<0.001*
電氣安全(1)	0.54±0.50	0.56±0.50	0.812	0.41
急救(3)	0.56±0.30	0.65±0.30	8.030	<0.001*

* $p<0.01$

表 12. 不同學群背景學生的前測分數 T 檢定結果與進步程度回歸分析結果(n=930, 25 題)

議題	學群	Pretest T–Test (t, *p*-Value)	Posttest	Paired-t	*p*–Value	Regression [A] β ± SE	*p*–Value
化學性危害	自然組	0.68±0.33	0.73±0.32	4.36	<0.001*	0.017±0.021	0.41
	社會組	0.57±0.34	0.65±0.35	4.24	<0.001*	-	
		(t=4.59, p<0.001*)					
危害通識	自然組	0.71±0.31	0.79±0.30	4.95	<0.001*	-0.001±0.021	0.95
	社會組	0.65±0.32	0.77±0.31	5.10	<0.001*	-	
		(t=2.66, *p*=0.008*)					
生物性危害	自然組	0.77±0.26	0.82±0.22	4.66	<0.001*	0.012±0.016	0.44
	社會組	0.76±0.24	0.81±0.24	2.49	0.013	-	
		(t=0.29, *p*=0.77)					
噪音	自然組	0.77±0.30	0.82±0.28	4.03	<0.001*	0.019±0.018	0.31
	社會組	0.70±0.29	0.77±0.29	3.91	<0.001*	-	
		(t=3.27, *p*=0.001*)					
游離輻射	自然組	0.88±0.33	0.89±0.31	1.12	0.26	-0.019±0.021	0.367
	社會組	0.90±0.30	0.92±0.27	1.10	0.27	-	
		(t=-1.01, *p*=0.31)					
非游離輻射	自然組	0.78±0.56	0.74±0.44	1.71	0.09	0.038±0.031	0.22
	社會組	0.78±0.41	0.70±0.46	-2.58	0.01	-	
		(t=0.02, *p*=0.99)					
個人防護具	自然組	0.65±0.48	0.83±0.38	8.10	<0.001*	0.038±0.027	0.17
	社會組	0.65±0.48	0.78±0.42	4.13	<0.001*	-	
		(t=0.23, *p*=0.82)					
呼吸	自然組	0.57±0.29	0.66±0.30	6.63	<0.001*	0.001±0.020	0.95
	社會組	0.56±0.28	0.66±0.29	4.90	<0.001*	-	

防護		(t=0.75, *p*=0.45)					
人因工程	自然組	0.67±0.34	0.80±0.29	8.43	<0.001*	0.062±0.022	0.005*
	社會組	0.65±0.34	0.74±0.34	3.39	0.001*	-	
		(t=1.04, *p*=0.30)					
電腦作業危害	自然組	0.53±0.50	0.75±0.43	9.65	<0.001*	0.107±0.031	0.001*
	社會組	0.50±0.50	0.63±0.48	3.72	<0.001*	-	
		(t=0.91, *p*=0.36)					
火災爆炸	自然組	0.74±0.24	0.79±0.23	4.56	<0.001*	0.036±0.017	0.03
	社會組	0.71±0.24	0.75±0.24	2.36	0.019	-	
		(t=1.59, *p*=0.11)					
電氣安全	自然組	0.58±0.49	0.59±0.49	0.20	0.85	0.068±0.035	0.05
	社會組	0.44±0.50	0.48±0.50	0.98	0.33	-	
		(t=3.98, *p*<0.001*)					
急救	自然組	0.55±0.30	0.64±0.30	6.57	<0.001*	-0.027±0.021	0.20
	社會組	0.58±0.30	0.67±0.30	4.44	<0.001*	-	
		(t=-1.41, *p*=0.16)					

* $p < 0.01$

[A]: 回歸模式共控制下列 2 變項:年級、前測成績

表 13. 介入研究之學生基本資訊

	介入組(n)	對照組(n)	χ^2	*p*–Value
性別				
男	38	38	0.187	0.67
女	68	60		
年級				
1	18	13	19.808*	<0.001
2	39	58		
3	15	18		
4	35	9		
學院				
文學院	24	20	4.465	0.22
社科學院	51	39		
生命與健康學院	10	19		
理工學院	22	20		
是否修過安全衛生課程				
有	0	7	7.913*	0.01
沒有	107	91		
是否有打工				
有	86	66	5.203*	0.02
沒有	19	31		
打工處是否進行安衛教育訓練				
有	13	17	2.669	0.10
沒有	73	49		
是否曾打工受傷				
有	31	18	1.179	0.28
沒有	55	47		
是否有親友在工作時意外受傷過				
有	28	21	1.638	0.44
沒有	42	37		
不知道	33	39		
是否有親友擔任安衛相關工作				
有	6	0	5.776	0.06
沒有	81	78		
不知道	18	19		
課前是否聽說過「安全衛生」				
有	77	70	0.004	0.95
沒有	28	26		

* p <0.05

表 14. 介入組與對照組的基礎安全衛生認知、態度、自我效能與行為意向之比較

	介入組	對照組	T	*p*–Value
	Mean ±SD (n)			
安全衛生認知				
全部	0.50±0.12 (107)	0.51±0.13 (98)	-0.232	0.82
化學性危害	0.30±0.29 (106)	0.26±0.26 (98)	1.133	0.26
危害通識	0.58±0.27 (106)	0.58±0.30 (97)	-0.221	0.83
游離輻射	0.55±0.24 (107)	0.60±0.25 (96)	-1.497	0.14
呼吸防護	0.64±0.27 (107)	0.66±0.30 (97)	-0.567	0.57
個人防護具	0.73±0.33 (107)	0.69±0.32 (97)	0.839	0.40
噪音	0.49±0.29 (106)	0.51±0.32 (97)	-0.534	0.59
非游離輻射	0.38±0.27 (106)	0.38±0.26 (97)	-0.064	0.95
生物性危害	0.45±0.31 (106)	0.48±0.32 (97)	-0.780	0.44
安全衛生態度				
一般安全意識	4.16±0.45 (107)	4.17±0.51 (98)	-0.159	0.87
特定安全意識	4.02±0.38 (107)	4.04±0.44 (98)	-0.316	0.88
一般安全行為	3.93±0.45 (107)	3.97±0.52 (97)	-0.470	0.64
特定安全行為	3.42±0.47 (107)	3.50±0.46 (97)	-1.193	0.23
安全衛生自我效能	3.76±0.72 (107)	3.73±0.63 (97)	0.324	0.75
安全衛生行為意向	3.05±0.41 (105)	3.02±0.36 (97)	0.564	0.57

表 15.有參加後測與未參加後測者的安全衛生認知、態度、自我效能與行為意向前測比較

	參加後測	未參加後測	T	*p*–Value
	Mean ±SD (n)			
介入組				
安全衛生認知	0.50±0.12 (83)	0.51±0.12 (24)	-0.492	0.62
安全衛生態度	3.87±0.35 (83)	3.94±0.24 (23)	-0.973	0.33
安全衛生自我效能	3.50±0.63 (81)	3.50±0.54 (23)	-0.002	0.98
安全衛生行為意向	3.04±0.42 (81)	3.12±0.36 (23)	-0.853	0.40
對照組				
安全衛生認知	0.51±0.10 (75)	0.46±0.15 (15)	1.540	0.13
安全衛生態度	3.91±0.43 (76)	3.91±0.32 (15)	0.000	1.00
安全衛生自我效能	3.61±0.64 (75)	3.59±0.68 (15)	0.097	0.92
安全衛生行為意向	3.03±0.35 (75)	2.93±0.43 (15)	0.906	0.37

表 16. 安全衛生認知在前測、後測與延宕測的比較結果

組別	項目	前測	後測	延宕測	前測&後測	前測&延宕測	後測&延宕測
		Mean ±SD	Mean ±SD	Mean ±SD	Paired-t (*p*)	Paired-t (*p*)	Paired-t (*p*)
介入組	全部	**0.49±0.12**	**0.65±0.14**	**0.65±0.14**	**8.585* (<0.001)**	**7.685* (<0.001)**	**0.201 (0.84)**
(62)	化學性危害	0.30±0.28	0.49±0.30	0.57±0.30	4.617* (<0.001)	5.803* (<0.001)	2.249* (0.03)
	危害通識	0.54±0.29	0.78±0.24	0.67±0.24	5.709* (<0.001)	2.794* (0.01)	-3.303* (0.002)
	游離輻射	0.54±0.26	0.73±0.23	0.75±0.22	4.589* (<0.001)	5.360* (<0.001)	0.782 (0.44)
	呼吸防護	0.62±0.27	0.67±0.26	0.72±0.24	1.051 (0.30)	2.746* (0.01)	1.454 (0.15)
	個人防護具	0.71±0.33	0.86±0.22	0.88±0.23	3.028* (0.004)	3.689* (<0.001)	0.567 (0.57)
	噪音	0.45±0.29	0.50±0.29	0.54±0.28	0.956 (0.34)	2.052* (0.04)	1.000 (0.32)
	非游離輻射	0.36±0.27	0.59±0.28	0.61±0.34	4.300* (<0.001)	4.882* (<0.001)	0.582 (0.56)
	生物性危害	0.48±0.33	0.53±0.29	0.58±0.31	1.196 (0.24)	2.392* (0.02)	1.384 (0.17)
對照組	全部	**0.51±0.10**	**0.54±0.10**	**0.52±0.14**	**1.989 (0.05)**	**0.805 (0.42)**	**-0.899 (0.37)**
(62)	化學性危害	0.26±0.25	0.31±0.24	0.36±0.25	1.236 (0.22)	2.605* (0.01)	1.458 (0.15)
	危害通識	0.61±0.28	0.54±0.25	0.59±0.26	-1.584 (0.12)	-0.354 (0.73)	1.456 (0.15)
	游離輻射	0.60±0.24	0.62±0.21	0.59±0.26	0.683 (0.50)	-0.314 (0.76)	-1.095 (0.28)
	呼吸防護	0.65±0.30	0.71±0.27	0.69±0.27	1.387 (0.17)	0.882 (0.38)	-0.531 (0.60)
	個人防護具	0.72±0.30	0.67±0.28	0.77±0.32	-1.229 (0.22)	0.903 (0.37)	2.049 (0.05)
	噪音	0.48±0.32	0.47±0.27	0.48±0.30	-0.119 (0.91)	0.112 (0.91)	0.222 (0.83)
	非游離輻射	0.40±0.24	0.39±0.25	0.33±0.28	-0.190 (0.85)	-1.436 (0.16)	-1.199 (0.24)
	生物性危害	0.45±0.29	0.52±0.28	0.47±0.27	1.758 (0.08)	0.480 (0.63)	-1.146 (0.26)

* p <0.05

表 17. 安全衛生態度、自我效能與行為意向在前測、後測與延宕測的比較結果

組別	項目	前測	後測	延宕測	前測&後測	前測&延宕測	後測&延宕測
		Mean ±SD	Mean ±SD	Mean ±SD	Paired-t (*p*)	Paired-t (*p*)	Paired-t (*p*)
介入組	態度	3.83±0.31	4.00±0.41	4.02±0.40	3.198*(0.002)	3.568*(0.001)	0.322 (0.75)
(62)	一般安全意識	4.09±0.46	4.17±0.49	4.11±0.49	1.377 (0.17)	0.318 (0.75)	-1.221 (0.23)
	特定安全意識	3.99±0.39	4.05±0.42	4.05±0.42	0.904 (0.37)	1.038 (0.30)	0.104 (0.92)
	一般安全行為	3.90±0.42	4.08±0.51	4.10±0.52	2.757* (0.01)	2.913* (0.01)	0.350 (0.73)
	特定安全行為	3.36±0.36	3.71±0.54	3.80±0.50	5.238* (<0.001)	7.509* (<0.001)	1.653 (0.10)
	安全衛生自我效能	3.48±0.69	3.74±0.69	3.81±0.63	2.917*(0.005)	3.967* (<0.001)	0.960 (0.34)
	安全衛生行為意向	3.01±0.40	3.06±0.51	3.21±0.46	0.946 (0.35)	2.987* (0.004)	2.038* (0.04)
對照組	態度	3.90±0.42	4.01±0.34	3.94±0.38	2.204*(0.03)	0.761 (0.45)	-1.622 (0.11)
(62)	一般安全意識	4.17±0.53	4.23±0.44	4.14±0.43	0.897 (0.37)	-0.609 (0.55)	-1.520 (0.13)
	特定安全意識	4.02±0.45	4.10±0.37	4.00±0.42	1.588 (0.12)	-0.424 (0.67)	-1.840 (0.71)
	一般安全行為	3.97±0.55	4.19±0.53	4.06±0.51	2.786* (0.007)	1.154 (0.25)	-1.746 (0.09)
	特定安全行為	3.45±0.45	3.52±0.42	3.54±0.46	1.542 (0.13)	1.672 (0.10)	0.380 (0.71)
	安全衛生自我效能	3.57±0.56	3.78±0.64	3.73±0.63	2.433*(0.02)	2.052 (0.05)	-0.714 (0.48)
	安全衛生行為意向	3.03±0.35	3.05±0.44	3.06±0.45	0.367(0.72)	0.434 (0.66)	0.154 (0.88)

* p <0.05

表 18. 以廣義估計方程式(GEE model)分析大學生安全衛生認知、態度與行為意向之介入成效

因子	認知		一般安全行為		特定安全行為		自我效能		行為意向	
	β (95% C.I.)	*p*	β (95% C.I.)	*p*	β (95% C.I.)	*p*	β (95% C.I.)	*p*	β (95% C.I.)	*p*
測驗別										
前測 (參考組)	0		0		0		0		0	
後測	0.092* (0.070-0.114)	<0.001	0.206* (0.127-0.286)	<0.001	0.207* (0.131-0.283)	<0.001	0.191* (0.090-0.291)	<0.001	0.060 (-0.009-0.129)	0.09
延宕測	0.087* (0.062-0.113)	<0.001	0.173* (0.088-0.258)	<0.001	0.253* (0.177-0.329)	<0.001	0.181* (0.074-0.288)	0.001	0.118* (0.035-0.201)	0.01
組別										
對照組 (參考組)	0		0		0		0		0	
介入組	0.066* (0.040-0.093)	<0.001	-0.018 (-0.143-0.108)	0.78	0.134* (0.007-0.261)	0.04	-0.025 (-0.190-0.141)	0.77	0.079 (-0.025-0.184)	0.14

* $p < 0.05$

+此模式控制下列變項：性別、科系背景、年級、打工經驗、打工的教育訓練經驗、是否有親友任職工安相關工作

表 19. 以廣義估計方程式(GEE model)分析大學生安全衛生認知、態度與行為意向之介入成效(新增相乘變項：介入組別×測驗別)

因子	認知		一般安全行為		特定安全行為		自我效能		行為意向	
	β (95% C.I.)	*p*	β (95% C.I.)	*p*	β (95% C.I.)	*p*	β (95% C.I.)	*p*	β (95% C.I.)	*p*
測驗別										
前測 (參考組)	0		0		0		0		0	
後測	0.040* (0.012-0.069)	0.01	0.204* (0.081-0.326)	0.001	0.058 (-0.041-0.156)	0.25	0.139 (-0.006-0.284)	0.06	0.023 (-0.082-0.128)	0.67
延宕測	0.026 (-0.007-0.060)	0.13	0.110 (-0.008-0.227)	0.07	0.083 (-0.022-0.188)	0.12	0.067 (-0.097-0.232)	0.42	0.019 (-0.103-0.141)	0.76
組別										
對照組 (參考組)	0		0		0		0		0	
介入組	0.007 (-0.027-0.040)	0.70	-0.055 (-0.206-0.096)	0.47	-0.025 (-0.169-0.119)	0.74	-0.114 (-0.301-0.074)	0.23	0.005 (-0.113-0.123)	0.93
組別×測驗別										
參考組	0		0		0		0		0	
介入組×後測	0.097* (0.056-0.139)	<0.001	0.003 (-0.158-0.163)	0.98	0.283* (0.137-0.429)	<0.001	0.097 (-0.103-0.296)	0.34	0.068 (-0.071-0.207)	0.34
介入組×延宕測	0.114* (0.065-0.163)	<0.001	0.120 (-0.048-0.288)	0.16	0.318* (0.173-0.463)	<0.001	0.217* (0.006-0.428)	0.04	0.190* (0.027-0.353)	0.02

* $p < 0.05$

+此模式已控制下列變項：性別、科系背景、年級、打工經驗、打工的教育訓練經驗、是否有親友任職工安相關工作

Quadrant B

急救 (1.92, 2.71)
生物性危害 (1.94, 2.70)
意外災害的分析與預防 (1.93, 2.63)
危害健康風險評估(1.86, 2.60)
生物偵測 (1.74, 2.59)
危害控制 (1.86, 2.58)

R = 0.694, n = 6, p = 0.126

Quadrant A

緊急應變 (2.18, 2.97)
火災爆炸 (2.26, 2.83)
個人防護具 (2.14, 2.82)
健康管理 (2.11, 2.80)
電腦作業危害 (1.95, 2.68)
危害通識 (1.97, 2.67)
呼吸防護 (1.99, 2.65)
化學性危害 (1.95, 2.62)

R= 0.863, n = 8, p = 0.006

Quadrant C

游離輻射(1.72, 2.56)
人因工程 (1.75, 2.55)
實驗室危害物質標示(1.91, 2.51)
振動危害防治(1.87, 2.51)
暴露評估 (1.83, 2.51)
非游離輻射 (1.64, 2.47)
實驗室廢棄物 (1.94, 2.41)
機械安全 (1.86, 2.41)
熱危害 (1.82, 2.41)
實驗室安全衛生概論(1.89, 2.31)
實驗室安全衛生法規(1.94, 2.30)
營建安全 (1.72, 2.26)

R = - 0.250, n = 12, p = 0.433

Quadrant D

噪音 (2.26, 2.57)
電氣安全(1.97, 2.56)
實驗室危害認知(1.95, 2.56)
通風(2.07, 2.55)

R = 0.547, n = 4, p = 0.453

學習興趣

高學習興趣 (score>2.57)

2.57

低學習興趣 (score≦2.57)

1.94

低了解程度(score≦1.94) **高了解程度(score>1.94)**

了解程度

圖 1. 大學生對於 30 個安全衛生議題的學習興趣與了解程度(括號中表示該議題的平均了解程度與學習興趣)

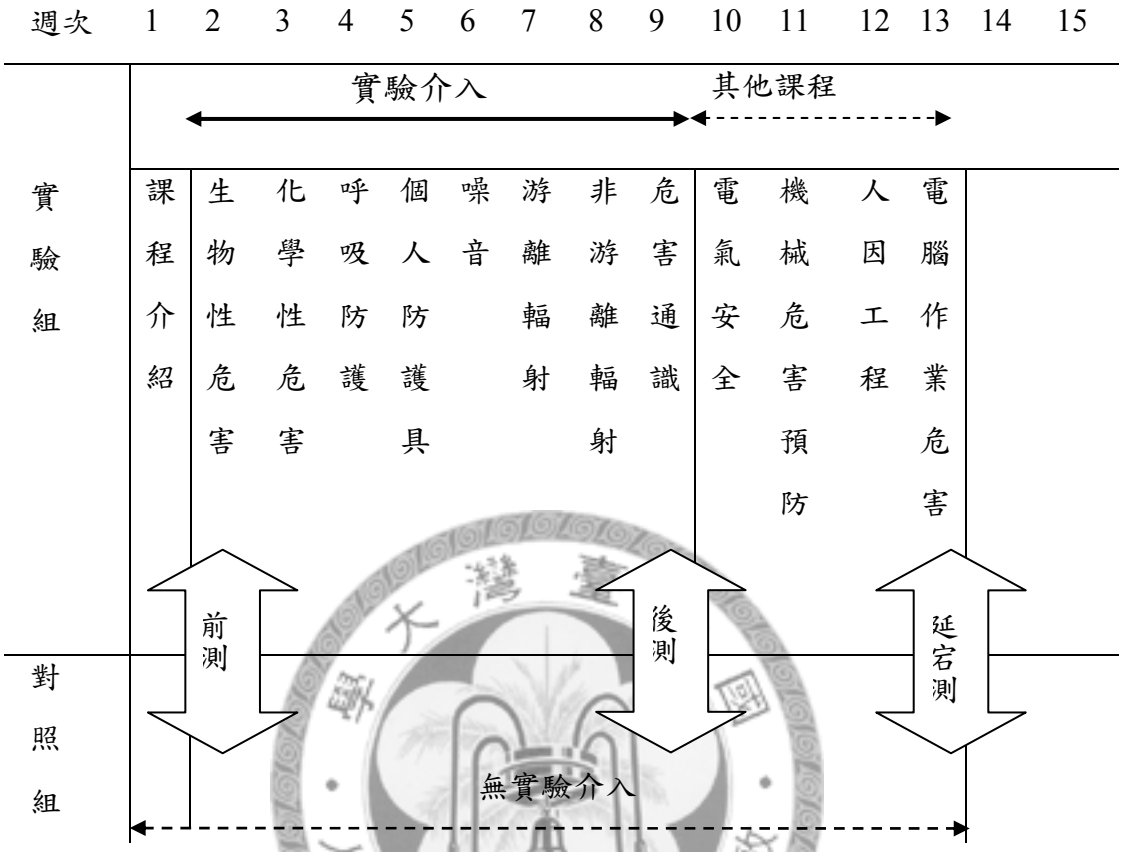

圖 2. 介入研究時間順序與課程規劃示意圖

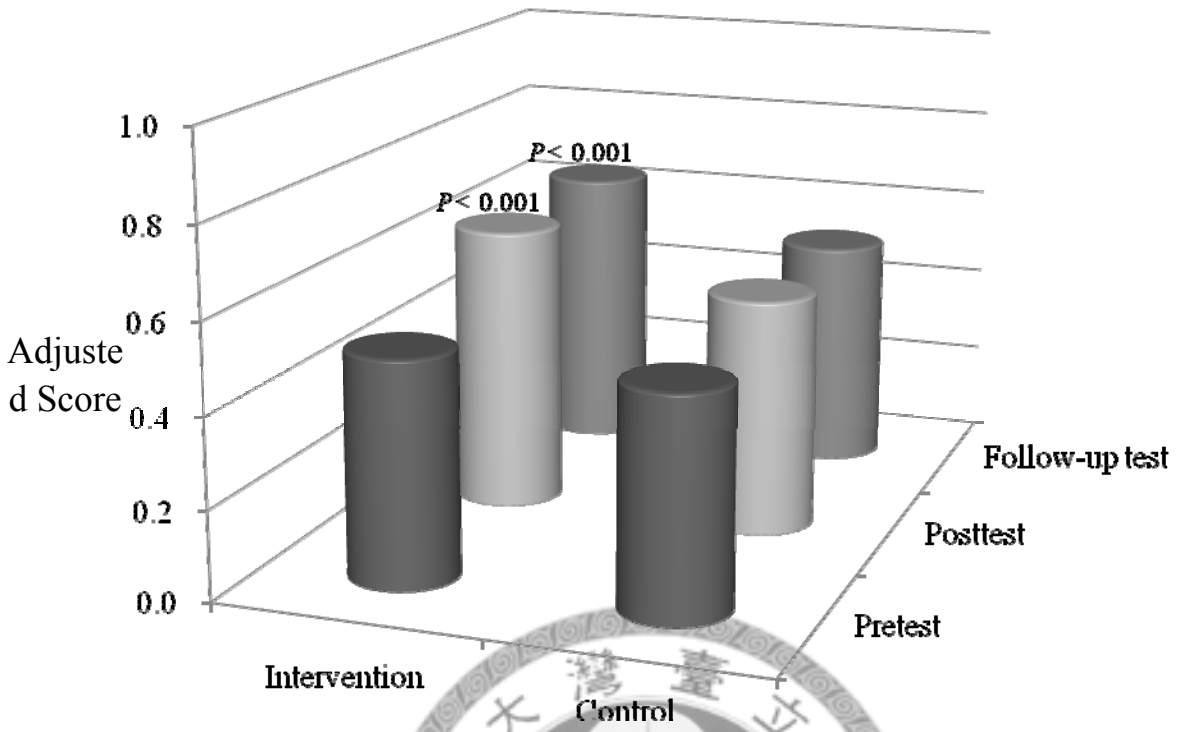

圖 3.廣義估計方程式下介入與重複施測對於安全衛生認知的調整分數

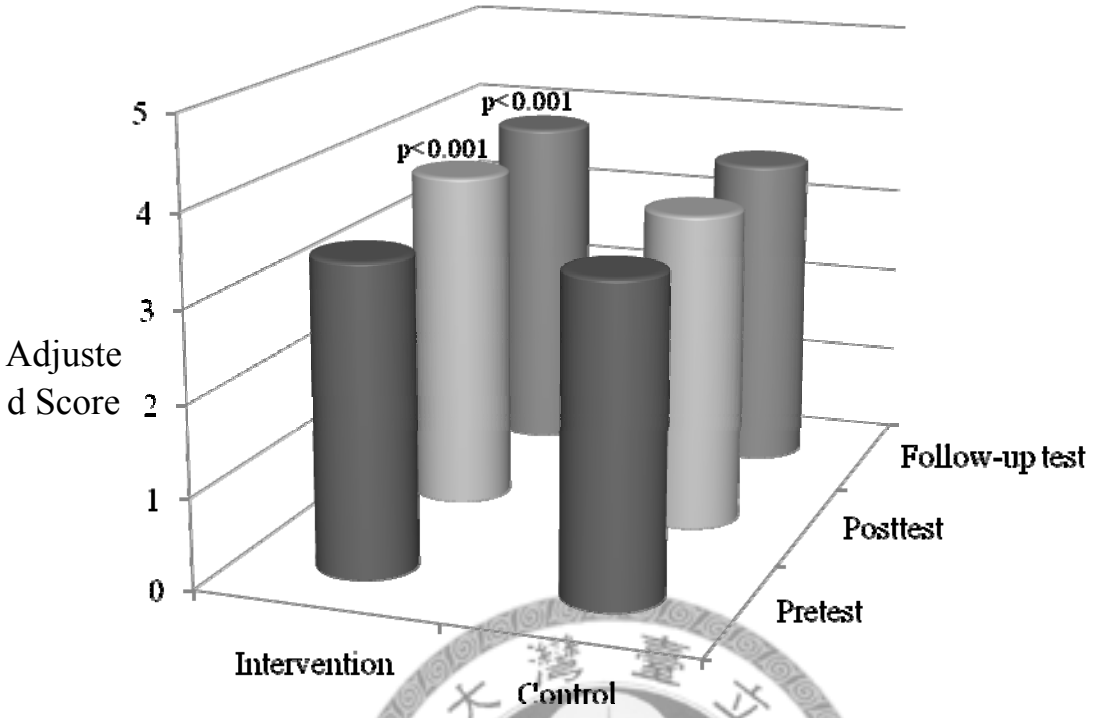

圖 4. 廣義估計方程式下介入與重複施測對於態度(特定安全行為)的調整分數

附件一

「學校安全衛生通識教育課程內容」意見調查

為落實校園安全衛生相關管理並能普及大專學子安全衛生的教育，使安全衛生的知識成為生活的一部份，避免因不知不能造成令人扼腕的意外事件，故教育部環保小組委託執行「實驗場所安全衛生教育推動計畫」。本項意見調查即為該項委託設計，希望能瞭解大學學生對於「實驗場所安全衛生通識課程」的看法，以作為教育部環保小組規劃推動相關課程之參考。您的回答將對該項課程規劃有非常大的貢獻，謝謝您！

台灣大學環境衛生研究所 敬啟

問卷填寫說明：

1. 本問卷為不記名調查，請安心填寫。
2. 本問卷採用勾（圈）選方式，請依每個問題所附之答案及與程度進行回答。
3. 對於問卷設計內容若有其他建議，請表達於「綜合建議」欄。

一、您的基本資料

學校：	系（所）別：
年級：	性別： □男 □女

二、請問您有選修過「安全衛生」相關的通識課程嗎？

□有，課程名稱為：_____ □沒有

三、如果學校開設一門「實驗場所安全衛生通識課程」，您有興趣去選修這堂課嗎？

□ 有興趣（續答 3.1 題） □沒興趣（續答 3.2 題）□不知道（續答 3.3 題）

3.1 有興趣修課的原因：（可複選）

□這門課聽起來好像很好玩

□這門課看起來應該有點用

□對安全衛生有興趣

□其他：_____

3.2 沒興趣修課的原因：（可複選）

□這門課聽起來好像很無聊

□安全衛生跟我沒有甚麼關係

□其他：_____

3.3 不知道的原因：

_____

四、如果學校開設一門「實驗場所安全衛生通識課程」，課程可能包括下列各項議題，您是否有意願去認識這些議題內涵？以及您對這些議題的瞭解程度？

議題名稱	學習意願				瞭解程度			
	完全沒意願<……>非常有意願				**完全不瞭解<····>完全瞭解**			
1.呼吸防護	1	2	3	4	1	2	3	4

2.游離輻射	1	2	3	4	1	2	3	4
3.非游離輻射	1	2	3	4	1	2	3	4
4.生物偵測	1	2	3	4	1	2	3	4
5.危害通識	1	2	3	4	1	2	3	4
6.生物性危害	1	2	3	4	1	2	3	4
7.個人防護設備	1	2	3	4	1	2	3	4
8.通風原理	1	2	3	4	1	2	3	4
9.化學性危害	1	2	3	4	1	2	3	4
10.暴露評估	1	2	3	4	1	2	3	4
11.實驗室安全衛生法規	1	2	3	4	1	2	3	4
12.噪音危害	1	2	3	4	1	2	3	4
13.火災爆炸	1	2	3	4	1	2	3	4
14.緊急應變	1	2	3	4	1	2	3	4
15.人因工程	1	2	3	4	1	2	3	4
16.危害健康風險評估技術	1	2	3	4	1	2	3	4
17.震動危害防治	1	2	3	4	1	2	3	4
18.健康檢查與管理	1	2	3	4	1	2	3	4
19.營造工程	1	2	3	4	1	2	3	4
20.熱危害	1	2	3	4	1	2	3	4
21.實驗室廢棄物	1	2	3	4	1	2	3	4
22.電氣安全	1	2	3	4	1	2	3	4
23.實驗室安全衛生概論	1	2	3	4	1	2	3	4
24.機械設備與安全	1	2	3	4	1	2	3	4
25.電腦作業危害與預防	1	2	3	4	1	2	3	4
26.實驗室急救	1	2	3	4	1	2	3	4
27.實驗場所危害認知	1	2	3	4	1	2	3	4
28.危害控制	1	2	3	4	1	2	3	4
29.事故之通報、調查、分析、處理及防範措施	1	2	3	4	1	2	3	4
30.實驗室危害物質標示	1	2	3	4	1	2	3	4
其他：								

綜合建議：

作答完畢，非常謝謝您的意見！

附件二

北區安全衛生教育中心評量試卷

說明：歡迎各位同學來修習此門通識課程。在此有一份試卷煩請各位填寫，本試卷之目的為想初步瞭解各位同學對安全衛生之認識，不影響同學之學期成績。謝謝各位的配合。

姓名：_____　　學號: _____

學校：_____

系級：_____系（科）　　年級：_____

(　　)1、下列何者不是肌肉骨骼傷害的原因？

（1）過度施力
（2）重複性工作
（3）無適當的休息
（4）吵雜的環境

(　　)2、A 類火災係指何種之火災?

（1）溶劑、油料類
（2）電氣
（3）木材、塑膠類
（4）可燃金屬類

(　　)3、下列何者不屬於實驗室藥品應標示之內容：

（1）實驗室名稱
（2）主要成分
（3）危害警告訊息
（4）製造商或供應商之名稱、地址及電話

(　　)4、2001 年 IARC 的報告中指出下列何種疾病可能與極低頻磁場有關？

（1）小兒腦瘤
（2）小兒淋巴瘤
（3）小兒白血病
（4）小兒先天畸形

(　　) 5、要避免在工作環境中傷害，下列何者是預防的最後一道之作為？
（1）在能量之發生源想辦法去改進
（2）使工作者不能進入危害源
（3）設法在發生源與工作者間設屏蔽
（4）個人防護具的使用

(　　) 6、下列何者不屬於電腦工作站的組成？
（1）電腦桌
（2）電腦椅
（3）視覺條件
（4）空調

(　　) 7、下列敘述何者為誤？
（1）一般電氣設備須實施定期檢查
（2）感電易因電流流通人體心臟而引起心室細動，造成死亡
（3）延長線可做為電源的延伸，容許過載
（4）電氣設備使用前，應清楚知道使用電壓及消耗電功率

(　　) 8、溶劑、油類火災不能用何種滅火劑滅火?
（1）二氧化碳
（2）泡沫
（3）水
（4）乾粉

(　　) 9、危害物質圖示之背景為藍色時代表何意義？
（1）爆炸性
（2）禁水性
（3）毒性
（4）氧化性

(　　) 10、下列何者不屬於非游離輻射？
（1）X 射線
（2）紅外線
（3）微波
（4）極低頻電磁場

(　　)11、在高溫高噪音的場所，你在做電熔接工作最好選用下列哪些防護具？
（1）耳塞、遮光面具
（2）耳罩、遮光面具
（3）耳塞、遮光眼鏡
（4）耳罩、遮光眼鏡

(　　) 12、打字時，手腕背屈會壓迫到？
（1）正中神經
（2）尺神經
（3）橈神經
（4）以上皆是

(　　) 13、我國作業場所之噪音音壓階(noise pressure level)暴露容許之設定，其容許暴露時間減半以多少分貝進階？
（1）3
（2）5
（3）80
（4）90

(　　) 14、某人觸電遇難搭救時應先？
（1）以乾燥絕緣物移開遇難者接觸之帶電體
（2）檢查心臟是否仍在跳動
（3）檢查呼吸是否正常
（4）用手拉開遇難者與帶電體後再行急救

(　　) 15、上方光源應安排在那個位置，不會對電腦作業者的眼睛造成影響？
（1）前面
（2）後面
（3）旁邊
（4）都可以

(　　) 16、當選用防護具時，以下何種態度是不正確的？
（1）選擇適合自己大小的防護具
（2）確實的穿戴
（3）在任何環境下都選用最高等級的防護具
（4）必須全程佩戴

(　　) 17、一般民眾接受天然輻射最大的來源為何？
（1）鈾 238
（2）氡氣
（3）宇宙射線
（4）食物

(　　) 18、某工廠自動生產線上之輸送帶電源線路，採用 8mm^{2}絞線並以 PVC 管配線，其允許之電流容量為 33 安培，則該電源線路之分路過電流開關（無熔絲開關），以下列何種額定電流為宜?
（1）30 安培
（2）40 安培
（3）50 安培
（4）以上皆可

(　　) 19、當吸氣時，呼吸防護具面體內的壓力相對於大氣壓力為大時，稱何種呼吸防護具？
（1）負壓式呼吸防護具
（2）正壓式呼吸防護具
（3）無壓式呼吸防護具
（4）無法分類

(　　) 20、口罩使用壽命的考量因素不包括下列何者？
（1）當濾材效率明顯降低時
（2）當感覺熱和不舒服時
（3）若重複使用時有接觸感染之虞時
（4）在衛生之考量下

(　　) 21、會導致以火災或爆炸方式危害人員的物質在危害通識規則中通稱為：
（1）危險物
（2）發火物
（3）爆裂物
（4）保安物品

(　　) 22、對於鼻出血的緊急處理，下列何者正確？
（1）讓患者坐下頭前傾
（2）不得壓出血側
（3）用溫毛巾敷鼻樑上方
（4）讓患者坐下頭後仰

(　　) 23、近紫外線除了會對皮膚造成傷害外，也常會對下列何種器官造成傷害？

(1) 睪丸
(2) 眼球
(3) 肝臟
(4) 牙齒

(　　) 24、下列何者不屬於個人輻射防護的一般原則？

(1) 減少滯留輻射場的時間
(2) 與物質或輻射場保持距離
(3) 必要時添加屏蔽物質以保護自己
(4) 攜帶各種防輻射藥物

(　　) 25、下列何者是噪音對健康之影響。

(1) 使人不易入睡、失眠
(2) 血壓升高及心跳速率增加
(3) 四肢與脊柱的屈肌反應
(4) 以上皆是

(　　) 26、下列何者為燒燙傷的處理原則：

(1) 以大量的冷水連續沖燒燙部位 1 分鐘後送醫
(2) 以大量的冷水連續沖燒燙部位 30 分鐘後送醫
(3) 鹼性化學物以酸性化學物沖洗中和
(4) 以無菌敷料加入冷水覆蓋傷口後包紮

(　　) 27、防護係數的定義為配戴呼吸防護具時，防護具內、外污染物的平均濃度之比值，所以當*防護係數越大*時，其所能提供的防護等級如何呢？

(1) 越高
(2) 越低
(3) 不一定
(4) 和防護係數無關

(　　) 28、在微生物的傳播方式中，為何【空氣傳播】是相當重要的傳播方式？

(1) 空氣的流動性使傳播方式範圍廣泛
(2) 人體呼吸的必然性
(3) 生物病原菌的不可見性
(4) 以上皆是

(　　) 29、下列何者為著火源?

（1）明火

（2）高溫表面

（3）靜電

（4）以上皆是

(　　) 30、一氧化碳對人體的毒性主要因為?

（1）一氧化碳本身有高毒性

（2）一氧化碳溶於水後有腐蝕性

（3）一氧化碳與血紅素的親和力為氧氣的 200 倍以上

（4）一氧化碳有刺激性

(　　) 31、下列何者不是靜態人體計測資料？

（1）手長

（2）座高

（3）腕部內翻

（4）身高

(　　) 32、下列何種裝備可以降低化學性危害之發生：

（1）防護鏡

（2）實驗衣

（3）手套

（4）以上皆是

(　　) 33、人體的哪一個器官或組織對游離輻射最為敏感?

（1）皮膚

（2）性腺

（3）乳腺

（4）肺

(　　) 34、對聲波特性的描述下列何者為是？

（1）聲音傳遞速度為：固體＞液體＞氣體

（2）聲音傳遞速度為：氣體＞液體＞固體

（3）聲音傳遞速度為：液體＞固體＞氣體

（4）以上皆非

(　　)35、意識不清的車禍傷者，疑似有頸椎受傷及下肢撕裂傷口整在流血，下列何種處理為錯：

（1）把傷者搬到車上，馬上送到附近醫院

（2）打 119

（3）檢查呼吸道，但不移動傷者

（4）傷口加壓止血

(　　) 36、過敏為生物性危害造成健康效應之一種，常見過敏原（物）包括：

（1）細菌或真菌的孢子

（2）節肢動物的排泄物

（3）花粉

（4）以上皆是

(　　) 37、烏腳病可能是因為下列何種物質引起：

（1）砷

（2）汞

（3）鎘

（4）鉛

(　　)38、人和其環境、工具或設備發生介面不協調而發生身體的不適，屬於何類危害？

（1）化學性危害

（2）物理性危害

（3）生物性危害

（4）人因工程危害

(　　) 39、請選出下列生物中以「絕對寄生」為主要生活形態者：

（1）病毒

（2）細菌

（3）真菌

（4）藻類

附件三

介入課程教案表

單元名稱	化學性危害			
教學時數	100 分鐘	教學對象	大學生	
教材來源	教育部安全衛生通識教材			
教學目標	一、認知： 1.認識毒理學基本概念與人體暴露化學物質之途徑。 2.了解劑量反應關係與暴露量的概念。 3.認識幾項常見化學物質所造成的危害。 4.認識健康風險的概念。 5.了解化學性危害的預防與控制原則。 二、情意： 1.藉由濫用藥物的說明，能提升學生拒絕毒品誘惑的態度。 三、技能：無			
教學目標	教學活動		時間	教學資源
	活動一：案例討論 藉由討論拿破崙死因開始帶入毒理學的概念。 教學活動		8 分鐘	案例圖片 PPT 檔案
1-1	1.教師介紹毒理學基本概念以及化學性物質進入人體的途徑。		15 分鐘	圖片
1-2	2.教師說明劑量反應關係進而介紹總暴露量的觀念與計算方式。 活動二、毒品的介紹		12 分鐘	計算案例
2-1	藉由解釋海洛因與搖頭丸的特性及對人體的毒性效應加強學生拒絕濫用藥物的意願。 教學活動		15 分鐘	
1-3	1.教師針對生活與工作環境中常見的化學性危害（殺蟲劑、環境汙染物、天然毒物、工業用化學物質、家庭中化學物質、食品添加物等）個別說明其作用機轉與影響。		25 分鐘	毒性作用機制圖片
1-4	2.教師介紹健康風險的觀念。		7 分鐘	
1-5	3.教師解釋化學性危害的預防與控制原則。 4.教師對於化學性危害的自我保護觀念作一總結。		15 分鐘 3 分鐘	

單元名稱	生物性危害		
教學時數	70 分鐘	教學對象	大學生
教材來源	教育部安全衛生通識教材		
教學目標	一、認知： 1.認識生物性危害的定義與特性 2.了解生物性物質之傳播途徑 3.學會生物危害的分級 二、情意： 1.能自我察覺日常生活中可能存在的生物性危害，並願意採取預防性措施。 三、技能： 1.當疾病流行時，學生能夠正確的執行防護措施。		

教學目標	教學活動	時間	教學資源
	活動一：案例說明 藉由說明幾則生物性危害的案例（SARS、禽流感、食物中毒等）帶出日常生活中生物性危害的存在。	7 分鐘	案例圖片 PPT 檔案
	教學活動		
1-1	1.教師介紹各種生物基本特徵與生物性危害的影響。	15 分鐘	各生物照片
1-2	2.教師說明生物性物質傳播的途徑。	20 分鐘	
1-3	3.教師解釋生物性危害分級制度。	10 分鐘	
2-1，3-1	4.教師介紹生物性危害預防與控制原則。	15 分鐘	
	活動二：防護口罩的選擇與佩戴		圖片
3-1	以不正確佩戴口罩之圖片提醒學生應該選用的口罩類型與佩戴注意事項，可呼應呼吸防護課程的講授。	3 分鐘	

<table>
<tr><td>單元名稱</td><td colspan="3">危害通識</td></tr>
<tr><td>教學時數</td><td>70 分鐘</td><td>教學對象</td><td>大學生</td></tr>
<tr><td>教材來源</td><td colspan="3">教育部安全衛生通識教材</td></tr>
<tr><td>教學目標</td><td colspan="3">一、認知方面
1. 認識危害通識的目的、益處與適用範圍
2. 了解危害通識傳遞有害化學物質資訊之架構
3. 認識全球調和系統(GHS)

二、情意方面：
1.藉由職業病案例促使學生能意識到日常生活中(或職場中)存在的危害物質，並願意進一步尋求正確資訊以保護自己。

三、技能方面：
1.當需要操作或是接觸危害物質時，學生能夠找到足夠且正確的資訊來幫助自己避免傷害的發生。
2.當生活中有化學槽車(或油罐車)在道路上翻覆時，能夠提供正確資訊給救援單位。</td></tr>
<tr><td>教學目標</td><td>教學活動</td><td>時間</td><td>教學資源</td></tr>
<tr><td>2-1</td><td>活動一 ：職業病範例介紹
教師藉由介紹過去幾例職業病例，以帶出工作場所中因無知所造成的嚴重結果。</td><td>10 分鐘</td><td>圖片，PPT 檔案</td></tr>
<tr><td>1-1

1-2，3-1，3-2</td><td>教學活動
1.教師介紹危害通識的目的、益處與適用範圍。
2.教師說明危害通識傳遞有害化學物質資訊之架構與三大工具。</td><td>10 分鐘

35 分鐘</td><td>

標示圖片</td></tr>
<tr><td>1-2</td><td>活動二：標示圖片猜一猜
利用大型標示圖片與範例搭配，請同學選擇正確的標示圖案。</td><td>5 分鐘</td><td>範例與標示圖片</td></tr>
<tr><td>1-3</td><td>教學活動
1.教師介紹全球調和系統(GHS)，並比較與現存危害通識架構之異同處。</td><td>10 分鐘</td><td></td></tr>
</table>

單元名稱	呼吸防護		
教學時數	100 分鐘	教學對象	大學生
教材來源	教育部安全衛生通識教材		
教學目標	一、認知方面 1.了解呼吸防護具的角色與定位 2.知道呼吸防護具的基本原理、種類、性能以及使用上的限制 3.認識密合度測試之方法及其重要性 4.學會呼吸防護具之維護、檢查與存放要點 二、情意方面 1.能自我省思日常生活中可能不正確的使用習慣，提升正確使用的意識。 三、技能方面 1.學會拋棄式呼吸防護具與防毒面具的正確穿戴方法		

教學目標	教學活動	時間	教學資源
1-1	活動一 ：個人使用經驗詢問 1. 教師詢問學生是否知道維持生命的重要元素有哪些？藉以引導出呼吸的重要性。 2. 再詢問學生平常使用口罩的習慣，詢問是否有戴過全面體或半面體呼吸防護具經驗，藉以開始課程。	10 分鐘	一般棉布口罩、醫療用拋棄式口罩、N95 口罩、全面體與半面體呼吸防護具
1-1 1-2	教學活動 1.介紹空氣污染物的種類與呼吸防護具的角色與使用時機。 2.說明呼吸防護具的種類、運作原理及配戴方式。	20 分鐘 30 分鐘	圖片與各式呼吸防護具實體（面體與濾毒罐等）、PPT 檔案
3-1	活動二：示範正確佩帶呼吸防護具 教師示範正確佩帶方式及提醒佩帶注意事項。	10 分鐘	N95 口罩、全面體呼吸防護具
2-1 1-3 1-4 2-1	教學活動 1.解釋如何選用正確的呼吸防護具。 2.介紹密合度測試及密合度檢點。 3.說明呼吸防護具維護、檢查與存放注意事項。 4.最後回顧正確選用與佩戴呼吸防護具的重要性。	10 分鐘 10 分鐘 8 分鐘 2 分鐘	圖片

單元名稱	個人防護具		
教學時數	100 分鐘	教學對象	大學生
教材來源	教育部安全衛生通識教材		
教學目標	一、認知方面 1.認識個人防護具的種類與使用時機 2.學會正確選擇個人防護具 3.了解個人防護具的清潔、保養與維護方式 二、情意方面 1.能自我省思日常生活欠缺的安全防護，並加提升危機意識。 三、技能方面 1.學會個人防護具正確穿戴方法		

教學目標	教學活動	時間	教學資源
	活動一 ：個人防護具基本介紹 1.教師先擺好各種個人防護具並介紹上課內容與順序，讓學生容易進入到上課情形。	5 分鐘	各式防護具實體擺置（安全帽、防護眼鏡、手套、耳罩、耳塞、防護衣等）圖片
1-1 2-1	教學活動 1.教師簡介所有個人防護具使用的時機與可供參考之各國標準。 2.教師舉例說明（影集、繪本圖片）不同國家對於個人防護具的重視程度。	8 分鐘	
1-2、1-3、3-1	活動二：安全帽 1. 教師先詢問同學戴不同安全帽的經驗與選擇安全帽的考量，藉以帶出不同安全帽與生活的連結。 2. 教師簡介安全帽的分類及設計用意，並分別針對騎乘機車用防護頭盔與工地用安全帽說明選擇方法、測試標準與使用注意事項。 3. 示範騎乘機車用防護頭盔的選用及配戴方式。	37 分鐘	機車安全帽、工地用安全帽 各種測試圖片
1-2、1-3、3-1	活動三：眼部與臉部個人防護具 1. 教師舉傷害案例（實驗室傷害案例、垃圾車噴濺案例、影集 CSI、醫護人員等）說	10 分鐘	安全眼鏡圖片

	明眼部與臉部個人防護具的重要性。 2. 教師分別說明種類、防護目的及各種選用參考標準及注意事項。		
1-2、1-3、3-1	活動四：防音防護具 1. 教師詢問同學戴耳罩與耳塞的經驗。 2. 教師介紹耳罩與耳塞各自的優缺點及選用參考依據。 3. 教師講解耳塞佩帶正確方法並請同學上台示範操作，並提醒佩帶注意事項。	15 分鐘	耳罩、耳塞
1-2、1-3、3-1	活動五：防護手套 1. 教師詢問同學平時使用手套的習慣及詢問是否認識各種類別的手套。 2. 教師分別說明各種手套的功用、選購參考及使用注意事項。	7 分鐘	各種不同類別手套（或圖片）
1-2、1-3、3-1	活動六：足部個人防護具 教師簡介安全鞋的類別、組成與保護目的，及使用注意事項。	7 分鐘	實物或照片
1-2、1-3、3-1	活動七：防護衣 教師說明化學防護衣的類別及其使用時機，並針對日常生活需要用到時間舉例說明。	6 分鐘	防護衣及照片
2-1、3-1	教學活動 教師再次提醒個人防護具所扮演的角色及回顧使用注意事項。並再次強調正確選用及正確佩戴的重要性。	5 分鐘	PPT 檔案

單元名稱	游離輻射		
教學時數	100 分鐘	教學對象	大學生
教材來源	教育部安全衛生通識教材		
教學目標	一、認知方面 1.認識游離輻射的來源、種類與特色 2.了解輻射劑量與健康效應 3.了解游離輻射的量測 4.學會個人輻射防護的原則 二、情意方面： 1.藉由說明日常生活中的各種游離輻射暴露來源讓學生減少因誤解而恐懼，並提升學生在面對醫療方面需求時可以正確選擇。 三、技能方面： 1.當學生有機會接觸放射性物質或操作輻射相關儀器時，能夠正確防護自己。		

教學目標	教學活動	時間	教學資源
	活動一 ：自由問答 1.教師先詢問學生對於輻射的直覺聯想與既有認知，加以釐清，以帶出輻射與生活的關聯。 2.教師進而說明游離輻射與非游離輻射的區別作為課程的開始。	10 分鐘	黑板(或白板)
	教學活動		
1-1，2-1	1. 教師介紹輻射發展史，來源，分類與特色。	15 分鐘	圖片與煙霧偵測器
	2. 教師利用圖片介紹生活中各種輻射的應用例子與其所佔日常生活暴露的比例。	15 分鐘	
1-2	3. 教師解釋劑量觀念與健康效應類別。	25 分鐘	
	活動二 ：影片播放與討論		
1-2	教師播放 K-19 影片，並於結束後詢問學生在影片中看到哪些情況，藉以加強學生對於急性暴露症狀之印象。	8 分鐘	影片片段
	教學活動		
1-3	1.教師利用圖片介紹各種輻射量測方法，並搭配例子（車諾比核電廠、醫院等）解釋各方法的應用時機	10 分鐘	圖片
1-4，3-1	2.教師介紹各種輻射防護的原則，並輔以圖片說明屏蔽的應用狀態。	17 分鐘	

單元名稱	非游離輻射		
教學時數	100 分鐘	教學對象	大學生
教材來源	教育部安全衛生通識教材		
教學目標	一、認知方面 1.認識非游離輻射的種類與應用 2.知道非游離輻射的生物效應 3.學會非游離輻射防護的原則 二、情意方面： 1.釐清現有各種電磁波的各種錯誤概念，並引發學生思考自身對於不確定的健康風險下所願意採取的生活方式。 三、技能方面：無		

教學目標	教學活動	時間	教學資源
	活動一 ：自由問答 1.教師先詢問學生是否還記得游離輻射與非游離輻射之差異為何，快速複習兩者的定義。輻射的直覺聯想與既有認知，加以釐清，以帶出輻射與生活的關聯。 2.教師進而詢問學生的手機與無線網路的使用情形，以及對於基地台、高壓電塔等的觀感，藉以帶出非游離輻射在生活中扮演的角色。	10 分鐘	黑板（或白板）、手機
	教學活動		
1-1	4. 教師介紹各種非游離輻射的來源與應用。	10 分鐘	PPT 檔案
1-1	5. 教師利用各種量測數據說明各種非游離輻射的暴露狀態。	25 分鐘	
1-2	6. 教師說明各種非游離輻射的生物效應。	25 分鐘	
	活動二：網路流言討論	5 分鐘	網路留言內容呈現
1-2	教師藉由網路流言（手機煮蛋乙例）釐清非游離輻射的生物效應。		
	教學活動		
1-2	1.教師說明非游離輻射生物效應確定之困難。	5 分鐘	PPT 檔案
1-3	2.教師介紹現有的非游離輻射的標準建議值，並解釋建議值的目的與目前的爭議。	10 分鐘 10 分鐘	
1-3，2-1	3.教師介紹防護的原則，並引導學生思考在不確定健康風險下可以採取的生活方式。		

單元名稱	噪音		
教學時數	100 分鐘	教學對象	大學生
教材來源	教育部安全衛生通識教材		
教學目標	一、認知： 1. 認識聲音的物理性質與單位。 2. 了解聽覺器官及生理。 3. 了解噪音的危害、量測及聽力的測試。 4. 認識不同場所噪音的控制標準。 5. 知道噪音控制的基本原則及個人防護設備。 二、情意： 1.能建立願意保護聽力的態度。 三、技能： 1.能正確選用及配戴個人噪音防護具。		

教學目標	教學活動	時間	教學資源
	活動一：詢問使用經驗 1.教師詢問同學平時使用 MP3（或 iPod）的習慣與頻率，藉以帶出日常生活可能導致聽力受損的活動。 2.再詢問同學是否有使用過耳罩或耳塞的經驗？感覺如何？進而開始介紹課程內容範圍。	7 分鐘	
1-1、1-2 1-3 1-3 1-4 1-5	教學活動 1.教師介紹聲音的物理性質與單位，聽覺器官的結構與功能。 2.教師說明噪音的定義、來源與噪音的健康危害。 3.教師解釋噪音測量的各種儀器及其適用時機。 4.教師介紹不同場所的噪音管制法規依據、計算原則與聽力檢查。 5.教師說明噪音控制的原則與防音防護具的選用及配戴。	10 分鐘 15 分鐘 10 分鐘 15 分鐘	耳朵圖片、PPT 檔案 噪音測量儀器圖片 耳塞與耳罩
3-1 2-1	活動二：耳塞佩戴示範 教師先講解耳塞佩戴的流程與注意事項，再請同學上台演練。 教學活動 以回顧聽力損失與提醒佩戴防音防護具的注意事項以增強學生願意採取預防聽力損失措施的感受。	20 分鐘 15 分鐘 8 分鐘	使用步驟圖片與耳塞

附件四

大專校院安全衛生認知與態度評量問卷

親愛的同學，您好

這是一份為瞭解您修習安全衛生通識課程的情形所設計的評估問卷，希望藉由您所提供的相關資訊作為進一步檢討與改善課程內容的依據，使得選修安全衛生通識課程的同學能夠收穫更多。請您放心這不是考試，也與您的成績無關，您所填寫的所有資訊均保密，僅供課程研究分析之用，絕對不外洩，請您安心填寫，謝謝您的協助與配合！

教育部第一區安全衛生教育中心 敬啟

一、 基本資料（請填寫文字或於選項前的□中打勾）

1. 學號：_____（此為編碼之用，請務必填寫,）

2. 性別：□ 男 □女

3. 學院：□文學院 □社會科學院 □理學院 □工學院

   □農學院 □醫學院 □進修推廣部 □其他_____

4. 科系：_____（請填寫全名）

5. 年級：□1年級 □2年級 □3年級 □4年級 □其他_____

6. 您進入大學「後」是否曾修過安全衛生相關課程(若不確定所修過的課程是否為安全衛生相關，亦可列出該門課程之名稱)？ □沒有 □有

   (若勾選**有**，請繼續填寫下列課程相關問題，若所修課程超過2種，請填寫距今最近的2個課程。**填寫範例如下：課程名稱：職業安全與健康 ，修課時間： 大一上 ，學分數： 2**)

課程名稱1：_____，修課時間：_____，學分數：_____

課程名稱2：_____，修課時間：_____，學分數：_____

7. 您進入大學「後」是否曾參加過安全衛生相關研習或訓練(若不確定曾參加過的研習或訓練是否為安全衛生相關，亦可列出該訓練或研習之名稱)？ □沒有 □有

   (若勾選**有**，請繼續填寫下列研習或訓練問題。若勾選**沒有**，請跳答第7題)

所參加之研習(訓練)名稱:_____，參加時間:_____，

研習(訓練)地點：_____，研習(訓練)時間長度：_____，

該研習(訓練)是否有舉行測驗：□沒有□有 (您是否通過該項測驗：□沒有 □有)

8. 您進入大學「前」是否曾有過安全衛生相關學習經驗(若不確定曾參加過的演講、課程、研習或訓練是否為安全衛生相關，亦可列出該演講、課程、研習或訓練之名稱)？

□ 沒有 □有（若勾選**有**，請繼續填寫下列問題。若勾選**沒有**，請跳答第8題）

該項學習經驗形式為何？

□校內演講（演講主題：_____）□校內課程（課程名稱：_____）

□相關研習或訓練活動（活動名稱：_____）□其他_____

9. 您是否有課外打工的經驗？ □沒有 □有

（若勾選**有**，請繼續填寫下列打工相關問題，若您有超過1個以上的打工經驗，請填寫您工作期間最長或是您覺得最危險的經驗。若勾選**沒有**，請跳答第9題）

請您簡述打工的工作內容：_____

您打工開始時雇主是否提供安全衛生教育訓練？

□沒有 □有，時間長度：_____

您是否曾經於工作時受過傷？□沒有 □有，受傷部位：_____，

嚴重程度：□住院 □門診治療 □在家休息 □不影響日常生活

10. 您是否有親友曾經在工作場所意外受傷(包含職業疾病、傷害、殘廢或死亡)？

□沒有 □有(意外種類:_____)□不知道

11. 您是否有親友從事安全衛生相關工作(如勞工安全衛生管理員、師等)？

□沒有 □有(工作職稱：_____) □不知道

12. 您在選修這堂課之前是否曾聽過「安全衛生」這個名詞？

□有（請繼續填寫下列問題）□沒有(跳答第二部份)

您是從什麼管道聽到「安全衛生」的？(可複選)

□大眾傳播(電視、電影、廣播、報章雜誌等) □學校課程或活動

□家人間的討論 □朋友或同學間的談論

□打工的環境 □網際網路 □□其他：_____

二、大專校院學生安全衛生認知評估

填答說明：以下的問題請您於(　)內填上您認為的答案

(　)1.降低化學危害暴露的基本原則，以下哪一項敘述**不**正確？(1)發生源的控制是最重要的 (2)個人防護具的佩戴是應該最優先考量的 (3)控制化學物質的傳輸途徑是管制的方法之一 (4)利用輪班方式減少暴露的也是一種方法。

(　)2.以下有關毒性與暴露的描述，哪一個是**不**正確的？(1)暴露等於毒性 (2)凡是物質皆具毒性 (3)當暴露量增加時，危害的發生率亦將隨之上升 (4)控制暴露量可有效管理危害。

(　)3.被我國勞工安全衛生相關法規歸類為「危險物」的化學物質具有下列哪一種危害？(1)致癌或致畸胎 (2)火災或爆炸 (3)致刺激性 (4)皮膚灼傷

(　)4.「危害通識」中將具有危害人員健康之物質通稱為？(1)有害物 (2)毒化物 (3)毒品 (4)特定化學物質。

(　)5.依危害通識之圖示規範，下列意涵與顏色配對組合中何者有**誤**？ (1)爆炸-橙色 (2)易燃-紅色 (3)氧化-藍色 (4)非易燃-綠色。

(　)6.物質安全資料表的更新頻率為何？(1)10年 (2)5年 (3)3年 (4)不用更新。

(　)7.下列人體哪一個內分泌腺對游離輻射最為敏感? (1)甲狀腺 (2)性腺 (3)乳腺 (4)腦下垂體。

(　)8. 下列何者**不**屬於個人輻射防護的一般原則？(1)減少滯留輻射場所的時間 (2)攜帶各種防輻射藥物 (3)與輻射物質或輻射場所保持距離 (4)必要時添加屏蔽物質以保護自己。

(　)9.以下哪一個**不**是在遭受急性大量輻射暴露後，一般能被立即「觀察」到症狀? (1)不孕 (2) 嘔吐 (3)失明 (4)皮膚燒傷。

(　)10.下列何者**不**是決定口罩使用壽命的考量因素？(1)濾材效率明顯降低 (2)感覺熱和不舒服 (3)重複使用而導致有接觸感染之虞 (4)合乎衛生考量。

(　)11.下列有關密合度測試時機的敘述，何者為**非**?(1)首次使用呼吸防護具或重新選用呼吸防護具後 (2)每年至少進行一次 (3)佩戴者的體重變化達百分之十以上時 (4)佩戴者裝置假牙或失去牙齒時可不需要進行密合度測試。

(　)12.若暴露於一個為 500ppm 濃度的甲苯環境中，選用呼吸防護具時，其防護係數(PF)值應該「至少」多少才有足夠的保護效用(甲苯的 TLV=50ppm)？ (1)PF=1 (2)PF=10 (3)PF=100 (4)PF=1000。

(　)13.下列何者是預防工作者在工作時受工作環境之危害的一道防線？(1)使用個人防護具 (2)工程控制 (3)行政管理 (4)工作實踐。

(　)14.下列有關耳塞佩戴與取下方法的敘述何者是**錯**的？(1)用食指與拇指搓揉壓縮耳塞

至耳道大小 (2)穿戴右耳時，左手由腦後繞至右耳位置，將右耳往上拉提，右手持耳塞慢慢置入耳道內 (3)固定耳塞位置，並等待耳塞膨脹至與耳道密合 (4)要取下耳塞時儘可能快速取下耳塞，以避免傷害耳朵。

(　)15.下列與人類聽覺有關的敘述，何者**不**正確? (1)出現聽力損失時，通常最早發生在 1000 Hz 之處 (2)長期處於噪音環境下，聽力損失將由暫時轉變成永久性(3)連續暴露於強大噪音之下會產生永久性聽力損失 (4)人耳對高頻率聲音較為敏感。

(　)16.哪些情境**不**適合耳塞的佩戴?(1)多灰塵環境 (2)需搭配其他防護具 (3)高溫、高濕作業 (4)需要經常講話。

(　)17.下列哪一個是噪音所引起的聽覺性效應? (1)身體其他器官或系統的失調或異常(2)內耳神經纖維萎縮退化 (3)與人交談的溝通障礙 (4)引起工作士氣低落。

(　)18.微波爐運轉時所產生的電磁波除了「微波」外還有何種電磁波？(1)紅外線 (2)紫外線 (3)雷射 (4)極低頻磁場。

(　)19.以下各種非游離輻射其能量高低的排序何者正確？(1)紅外線＞紫外線＞極低頻電磁場＞射頻輻射 (2)紫外線＞極低頻電磁場＞射頻輻射＞紅外線 (3)極低頻電磁場＞紅外線＞射頻輻射＞紫外線　(4)紫外線＞紅外線＞射頻輻射＞極低頻電磁。

(　)20.避免過度暴露於非游離輻射的方法中**不**包括以下何者？(1)降低暴露時間 (2) 增加與發生源的距離 (3)屏蔽 (4)利用替代物。

(　)21.2003年冠狀病毒引起的SARS及2001年美國911恐怖攻擊事件後，人們搶購個人防護具、藥物、加強軍演和消毒等現象，是生物性危害的何種特性？(1)感染 (2)過敏 (3)中毒 (4)心理恐慌。

(　)22.下列何項生物性危害的傳播途徑具有暴露之「不可見性」的特質？(1)經血液體液傳染 (2)空氣傳染 (3)動物咬傷 (4)以上皆是。

(　)23.我國行政院國家科學委員會(簡稱國科會)將生物危害分級分為幾級？　(1)一級 (2)二級 (3)三級 (4)四級。

下面還有喔，請繼續填答，謝謝！

三、大專校院學生安全衛生態度量表

填答說明：請您依據您想法的同意程度，在選項空格中勾選一個最適合答案。

題目	非常不同意	不同意	中立意見	同意	非常同意
〈一〉一般安全意識					
1.我認為安全衛生教育與意外事件的發生並無密切關係					
2.我認為工作場所的各種安全衛生管理制度與規定對於減少意外發生沒太多幫助					
3.我認為工作場所的意外發生是無法事先預防的					
4.我認為加強安全衛生教育可以改善工作者對「安全」的態度					
5.我相信安全的操作方式可以減少意外事故的發生					
6.我認為具危害健康的場所應該有警示標示					
7.我認為在工作場所中工作稍不注意就會影響個人或他人的安全與健康					
〈二〉特定安全意識					
1.我相信在危害物質上標示相關危害訊息是有助於預防傷害發生的					
2.我認為每個人都應該知道化學品標示的意義					
3.我認為使用化學物品前應該先了解該化學物質的特性					
4.我認為藥物是用來治療疾病的，多吃一點可以讓療效更快更好					
5.我認為殺蟲劑主要是用來殺昆蟲的，對人體不會有很大傷害					
6.我認為工作場所應重視聽力保護行為					
7.我認為感冒時戴口罩對於減少病菌傳播是有用的					
8.我認為工作中即使有戴手套，也要養成結束脫下手套後洗手的習慣					
9.因為天氣炎熱，可將工作服與安全眼鏡卸下以求舒適					
10.我認為個人防護具價格越貴效果越好					

題目	非常不同意	不同意	中立意見	同意	非常同意
11.我相信防護具穿戴的正確程度是防護效果的重要關鍵					
12.我認為只要是口罩，戴上就有保護效果					
13.我認為電腦或無線網路等非游離輻射對健康的影響是必須重視的					
〈三〉一般性安全行為					
1.工作時我會注意到他人的安全					
2..如果發現場所不安全的情況，我會很快向有關人員報告					
3.工作時我會隨時注意各項操作步驟的安全					
4.我會確實遵守工作場所的各項規定與標準操作程序					
5.在使用機器或工具前，我都會先檢查其安全設施					
6.用餐前我一定會洗手					
〈四〉特定安全行為					
1.我看得懂危險物標示的意義					
2.我會關心及了解所使用的有害物相關資訊					
3.當我感冒時一定會帶上口罩，以避免把病菌傳播給他人					
4.我使用殺蟲劑或是清潔劑前會先閱讀使用說明，並配戴適合的防護工具(如手套、口罩等)					
5.在醫院求診時，我不會主動要求進行X光、核磁共振等醫療檢查					
6.白天時即使沒有陽光，我仍會採取避免暴露紫外線的措施					
7.我願意儘可能減少使用手機的時間					
8.當預期會出現很大的聲響時，我會先摀住耳朵以減少聲音進入					
9.我能夠確認自己耳塞的佩戴是否正確					
10.當有需要時，我能夠選用正確的個人防護具(安全眼鏡、安全鞋等)					
11.我能依據實際需求判斷該使用何種呼吸防護具					

四、大專校院學生安全衛生自我效能量表

填答說明：當您進入工作職場後，面臨下列的情境，您可以做到的把握程度？請勾選。

題目	非常沒有把握	不太有把握	中立意見	有把握	非常有把握
1.即使公司在趕出貨、要求加快操作速度，我有把握以安全為第一優先。					
2.當工作環境有奇怪的氣味出現時，我會戴上口罩後再去找發出氣味的原因。					
3.當我需要操作腐蝕性物質時,我會先穿戴好手套與工作衣。					
4.我有把握可以忍耐工作環境的炎熱與穿戴個人防護用具所產生的不舒適。					
5.當公司沒有提供適合我臉部的呼吸防護具，我有把握跟公司提出需求，堅持使用適當的呼吸防護具。					
6.如果公司沒有提供足夠的耳塞給我使用，我有把握會主動跟公司提出需求。					

五、大專校院學生安全衛生行為意向量表

填答說明：請你就未來進入職場後，勾選會不會去執行下列的行為?

題目	一定會	可能會	可能不會	一定不會
1.未來進入職場後，我會參與各種安全衛生講習活動				
2.未來，我會主動收集安全衛生法規及相關職場災害案例				
3.未來，我會主動與家人及朋友分享職場安全衛生資訊				
4.未來進入職場後，我會主動協助他人避免受到職場健康的危害				
5.未來進入職場後，我會遵守職場安全衛生的規定。				

填寫結束，再次謝謝您的填寫！

附件五

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Perceptions of General Education on Occupational Health and Safety Among College Students in Taiwan

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Undergraduate students were surveyed to assess their awareness of and interest in health and safety education. Out of 5258 questionnaires distributed among 66 colleges and universities in Taiwan, 4474 questionnaires were returned. The respondents were asked to provide demographic information and to respond to questions about a proposed college course in general occupational health and safety (OHS) and questions about 30 OHS topics. Their awareness and learning interest about each topic were evaluated on a 4-point scale. Statistical analysis of variance and logistic linear regression were performed. Only 13% of respondents had previously taken health and safety courses. More than 39% of respondents indicated that they would take general OHS courses if the courses were offered by their colleges. Student motivation to take OHS courses was apparently related to their experience in OHS coursework, their academic background, and their current learning interest in the 30 OHS topics. Students with natural science or engineering backgrounds tended to express strong interest in OHS topics and courses. In conclusion, implementing general health and safety education in college is recommended. In addition, developing an OHS course module system would meet student expectations, as courses would consider the learning interests and needs of students with different college majors.

Keywords college general education, curriculum development, health awareness, industrial hygiene, occupational health, occupational health and safety education

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INTRODUCTION

Integrating occupational health and safety (OHS) into health education during early career training is recommended because management, organized labor, and government cannot always reliably and proactively provide job health and safety information needed for workers to protect themselves.[1] One study in the scientific literature described a program in which an OHS curriculum was successfully presented in nonvocational high school courses.[2]

Another study of 1126 students who had enrolled in health classes at eight Midwestern universities in the United States revealed that the classes significantly changed the safety values of students who completed the classes.[3] A study of hairdressing students in Taiwan revealed changed attitudes toward the safe handling of chemicals after the students received appropriate education and training in reducing hazardous chemical exposure. The authors of that study emphasized the need for primary prevention measures.[4]

Many university facilities such as laboratories and workshops pose worker health and safety hazards.[5,6] Universities rarely provide adequate education in occupational health and safety.[7–9] Several recent studies have concluded that OHS education should be integrated into the curriculum.[5,7,10] The authors of a comprehensive survey of Australian universities recommended OHS training for all undergraduate chemistry students.[7]

In the United States, the National Institute for Occupational Safety and Health (NIOSH) has initiated two educational projects to address health and safety education: (1) Minerva for business schools and Safety, and (2) Health Awareness for Preventive Engineering (SHAPE) for engineering schools.[11] NIOSH provides nine online instruction modules so that engineering instructors can easily include occupational health and safety instruction in their courses.[12] Topics of interest to university students included lifestyle issues, such as fitness, nutrition, stress management, depression, illness screening, and cold and flu prevention.[13]

In 2004, the Ministry of Education in Taiwan initiated the ISHALE (Integrate Safety and Health Awareness in Liberal Education) program, which was designed to enhance college-level occupational health and safety education, as most undergraduate students have limited opportunities to take OHS-related courses in college before entering the work force. In Taiwan, all citizens are required to complete a

9-year education program before admission to either a general senior high school or a vocational high school. Vocational high school students must immediately choose a major so they can take courses that teach the technical skills needed for specific occupations, whereas general senior high school students can decide whether to pursue further college studies in liberal arts, social sciences, life and health sciences, engineering, or physical sciences. The decision determines their course content during their sophomore and senior years. Students in the liberal arts and social science category are not required to take additional physics or chemistry courses.

To develop the ISHALE program, a survey of college students in Taiwan was conducted during 2003–2004 to assess student awareness of and interest in OHS topics and personal factors that may influence their motivation to take college OHS courses. Questionnaire results, which were used to develop the course modules, are described below.

METHODS

Survey Methodology

Multistage, stratified, systematic sampling design was used to obtain representative samples of current college students. During the 2002–2003 school year, there were 837,602 students in 776 departments of 158 colleges.[14,15] The departments were stratified into 16 academic communities according to the classification system used by the Taiwan Ministry of Education. The categories include (1) medicine and pharmacy; (2) life science; (3) agriculture, forestry, fishing, and ranching; (4) physical education and leisure management; (5) earth sciences; (6) mathematics, physics, and chemistry; (7) information technology and electronics; (8) engineering; (9) architecture and design; (10) education; (11) liberal arts; (12) arts; (13) law; (14) mass communications; (15) social sciences; and (16) business administration.

By using the principle of proportion probability, 239 departments were randomly selected from these communities. At least one student from a group with motivation to take OHS courses was included in the sample for each department. Assuming that at least 10% of students in each department were motivated, and setting type I error with $\alpha = 0.1$,[16] 22 students were systematically sampled from each selected department, and 5258 students were recruited. Questionnaires were distributed to students by the student affairs office of each department from March 2004 to June 2004. All questionnaires were completed anonymously and took about 10 min to complete.

The Questionnaire

The first part of the questionnaire requested demographic information, including gender, years of schooling, major, affiliated school (general college or vocational college), experience in health and safety coursework (yes or no), as well as motivation to take an OHS course if such a course was offered at college (yes, no, or undecided). The second part of the questionnaire evaluated learning interest and awareness regarding the 30 OHS topics.

For each topic, two questions were asked: (1) "If a course titled Occupational Health and Safety is offered, and the addressed topic is included in this course, would you be interested in learning the topic?" and (2) "How well do you understand the topic?" The students answered according to the 4-point Likert scale: 1 = definitely no, 2 = maybe, 3 = yes, to a moderate degree, 4 = definitely yes. For each respondent, a total score for awareness or learning interest was obtained by summing the scores on the 30 topics, and the score on each topic was obtained by converting the respondent response (4-point Likert scale about awareness of or learning interest in) into a numerical score in accordance with a prior assigned value.

Statistical Analysis

As Table I illustrates, the 16 academic communities were further separated into five academic groups that were categorized according to the college study pursuits of the senior high school students as described in the Introduction. The students who had selected liberal arts and social sciences majors were assumed to have less exposure to study core scientific disciplines, such as chemistry, physics, and biology. This difference was expected to affect their questionnaire responses. Statistical analyses were performed using SPSS version 12.0 and SAS version 8.2. Pearson chi-square tests were applied to compare respondent characteristics among the five academic groups. The tested characteristics included gender ratio, years of schooling, experience in OHS coursework, and motivation to take OHS courses.

Logistic regression models were used to estimate crude and adjusted odds ratios and their 95% confidence intervals for predictive factors associated with student motivation to take OHS courses. Predictive factors included demographic information (gender, years of schooling, school affiliation, academic groups, and experience in OHS coursework) and awareness of the 30 OHS topics and learning interest in them.

TABLE I. Grouping of Academic Communities

Academic Groups	Academic Community
Life and health sciences	Medicine, pharmacy, life science, agriculture, forestry, fishing, and ranching, physical education and leisure management
Physical sciences	Earth sciences, mathematics, physics and chemistry
Engineering	Information technology and electronics, engineering, architecture and design
Liberal arts	Education, liberal arts, arts
Social sciences	Law, mass communications, social sciences, business administration

TABLE II. Respondent Demographic Information

	Life and Health Sciences n (%)	Physical Sciences n (%)	Engineering n (%)	Liberal Arts n (%)	Social Sciences n (%)	Total n (%)
Gender						
Male	508 (43)	276 (67)	690 (76)	281 (32)	447 (42)	2202 (50)
Female	669 (57)	138 (33)	217 (24)	594 (68)	628 (58)	2246 (50)
Years of schooling						
Freshman	394 (33)	65 (16)	197 (22)	270 (31)	287 (28)	1213 (28)
Sophomore	295 (25)	150 (37)	346 (39)	330 (38)	337 (32)	1458 (33)
Junior	239 (20)	140 (34)	195 (22)	127 (15)	272 (26)	973 (22)
Senior	252 (22)	55 (13)	155 (17)	147 (16)	145 (14)	754 (17)
School affiliation						
General college	807 (68)	384 (92)	501 (55)	659 (75)	795 (74)	3146 (70)
Vocational college	377 (32)	31 (8)	414 (45)	221 (25)	285 (26)	1328 (30)

Awareness of as well as learning interest was estimated by quartiles based on total score. The level of significance was set to alpha < 0.05.

To evaluate learning interest associated with awareness, the 30 OHS topics were assigned to four quadrants, which underlined the overall mean for learning interest and awareness. A topic for which mean scores for both learning interest and awareness for that topic exceeded the overall means of the 30 topics was assigned to Quadrant A, which included topics with high learning interest and high awareness. Accordingly, Quadrants B, C, and D included topics with high learning interest and low awareness, topics with low learning interest and low awareness, topics with low learning interest and high awareness, respectively. Pearson correlation coefficient was used to assess the relationship between learning interest and awareness.

RESULTS

Sample Demographic Data

Table II gives the demographic data for the 4474 respondents from 239 departments of 66 colleges. Most (70%) respondents were general college students, and 30% were vocational college students. Fifty-six percent of the respondents were majors in life and health sciences, physical sciences, or engineering, and 47% were majors in liberal arts and social sciences. The overall gender ratio (male/female) approached one. The gender ratio significantly differed among the five academic groups (Pearson chi-square $\chi^2 = 456.742$, df $= 4$, $p < 0.001$); most males were engineering and natural science majors, whereas most females were liberal arts and social sciences majors. Most respondents were sophomores. Sophomores comprised 33% of the total respondents, while freshmen, juniors, and seniors comprised 28%, 22%, and 17%, respectively. The respondent years of schooling among the five academic groups significantly differed (Pearson chi-square $\chi^2 = 168.069$, df $= 12$, $p < 0.001$).

Experience in OHS Coursework

Table III shows that fewer than 13% of all participating students had taken OHS courses. Notably, the social sciences group had the lowest percentage (9%) of the five academic groups. The rate of experience in OHS coursework was, in decreasing order, as follows: life and health sciences, physical sciences, engineering, and liberal arts. The proportions of students with experience in OHS coursework differed statistically among academic groups (Pearson chi-square $\chi^2 = 24.388$, df $= 4$, $p < 0.001$).

Student Motivation to Take OHS Courses

Table IV presents the data indicating student motivation to take OHS courses if they were offered. Of the 3697 respondents who answered this question, only 47% had motivation to take

TABLE III. Experience in OHS Coursework for the Five Academic Groups

Experience in OHS Coursework	Life and Health Sciences n (%)	Physical Sciences n (%)	Engineering n (%)	Liberal Arts n (%)	Social Sciences n (%)	Total n
Yes	184 (16)	58 (14)	125 (14)	116 (13)	96 (9)	579
No	983 (84)	353 (86)	774 (86)	753 (87)	976 (91)	3839
Total	1167	411	899	869	1072	4418

Note: Pearson chi-square $\chi^2 = 24.388$, df $= 4$, $p < 0.001$.

TABLE IV. Student Motivation to Take OHS Courses Among Five Academic Groups

Motivation to Take OHS Courses	Life and Health Sciences n (%)	Physical Sciences n (%)	Engineering n (%)	Liberal Arts n (%)	Social Sciences n (%)	Total n
Yes	572 (57)	170 (49)	415 (55)	285 (41)	314 (36)	1756
No	439 (43)	180 (51)	340 (45)	418 (59)	564 (64)	1941
Total	1011	350	755	703	878	3697

Note: Pearson chi-square $\chi^2 = 112.604$, df = 4, $p < 0.001$.

such courses. The rates of having motivation to take OHS courses within academic group were 57% for life and health sciences, 55% for engineering, 49% for physical sciences, 41% for liberal arts, and 36% for social sciences. Motivation to take OHS courses significantly differed among the five groups (Pearson chi-square $\chi^2 = 112.604$, df = 4, $p < 0.001$).

The logistic regression in Table V indicates that years of schooling, gender, school affiliation, and awareness of OHS topics were not significantly related to motivation to take OHS courses, but academic background, experience in OHS coursework, and learning interest in the addressed OHS topics were significantly related to motivation. In comparison with the response in the social sciences academic group, those in the other academic groups tended to have stronger motivation to take OHS course (odds ratio = 1.42–1.69). The students with prior OHS coursework were highly motivated to take OHS courses (adjusted odds ratio = 2.40). Motivation was also related to student interest in the addressed OHS topics (odds ratio, 2.83 for the second quartile of learning interest; 9.01 for third quartile of learning interest; 22.11 for forth quartile of learning interest).

Awareness of and Learning Interest in the Addressed OHS Topics

The overall mean scores for awareness of and learning interest in the OHS topics were 1.94 and 2.57, respectively. The Pearson correlation coefficient between learning interest and awareness of the 30 topics was 0.61 ($n = 30$, $p < 0.001$).

Figure 1 shows that 8 of the 30 OHS topics were assigned to Quadrant A, since the scores for awareness and learning interest for a topic both exceeded the overall mean scores. The eight topics were (1) emergency response, (2) fire protection, (3) personal protective equipment, (4) health management, (5) hazards of computer operations, (6) hazard communication, (7) respiratory protection, and (8) chemical hazards. The learning interest associated with awareness within this course group had a Pearson correlation of 0.863 with $p = 0.006$.

Topics with high learning interest (mean score exceeding overall mean score) but low awareness (mean score less than or equal to overall mean score) fell into Quadrant B. The six topics included (1) first aid, (2) biological hazards, (3) analyzing and preventing accidents, (4) health risk assessment, (5) biological monitoring, and (6) hazard control. Learning interest associated with awareness within this course group had a Pearson correlation of 0.694 with $p = 0.126$.

Quadrant C included 12 topics with mean scores lower than or equal to the overall mean scores for the 30 topics: (1) ionizing radiation, (2) ergonomics, (3) labeling system

TABLE V. Predictors of Student Motivation to Take OHS Courses

Characteristic	Adjusted Odds Ratio (95% CI)
Years of schooling	
Freshman	1.00
Sophomore	0.83 (0.67–1.04)
Junior	0.78 (0.64–1.00)
Senior	0.89 (0.69–1.16)
Gender	
Female	1.00
Male	1.11 (0.93–1.33)
School affiliation	
Vocational college	1.00
General college	1.04 (0.86–1.27)
Experience in OHS coursework	
No	1.00
Yes	2.40 (1.87–3.09)[A]
Academic groups	
Social sciences	1.00
Liberal arts	1.15 (0.88–1.50)
Engineering	1.69 (1.28–2.22)[A]
Physical Sciences	1.42 (1.02–1.98)[A]
Life and health sciences	1.68 (1.31–2.14)[A]
Learning interest	
First quartile	1.00
Second quartile	2.83 (2.23–3.58)[A]
Third quartile	9.01 (7.09–11.46)[A]
Forth quartile	22.11 (16.07–30.43)[A]
Awareness	
First quartile	1.00
Second quartile	1.16 (0.93–1.46)
Third quartile	1.25 (0.99–1.58)
Forth quartile	0.89 (0.66–1.20)

[A] $p < 0.05$.

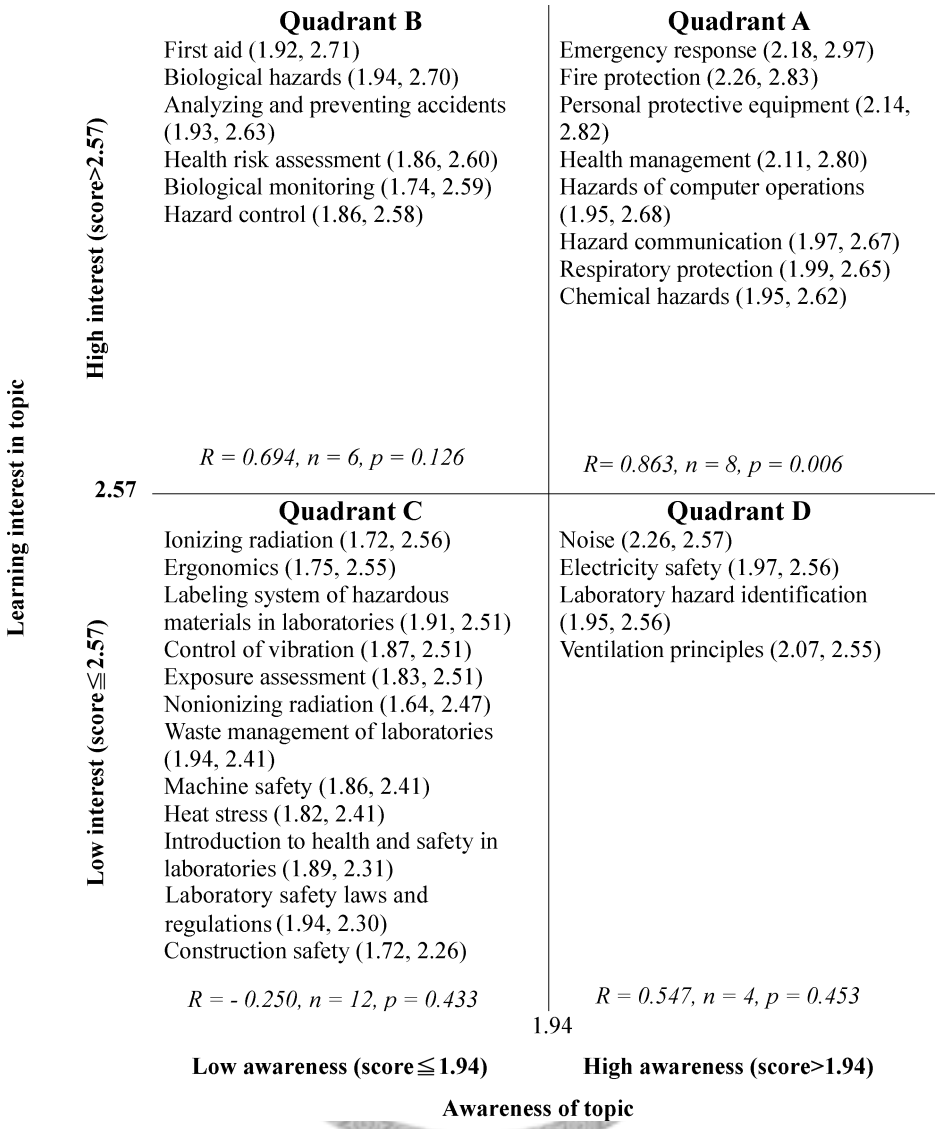

FIGURE 1. Awareness of and learning interest in the addressed OHS topics (numbers included in the parentheses are the mean score of awareness and the mean score of learning interest for each topic).

of hazardous materials in laboratories, (4) control of vibration, (5) exposure assessment, (6) nonionizing radiation, (7) waste management of laboratories, (8) machine safety, (9) heat stress, (10) introduction to health and safety in laboratories, (11) laboratory safety laws and regulations, and (12) construction safety. This course group revealed a nonsignificant negative correlation between learning interest and awareness (Pearson correlation = –0.250, p = 0.433).

Four topics were classified into Quadrant D with low learning interest (mean score less than or equal to overall mean score) but high awareness (mean score exceeding overall mean score): (1) noise, (2) electricity safety, (3) laboratory hazard identification, and (4) ventilation principles. The correlation between learning interest and awareness in this course group was not statistically significant (Pearson correlation = 0.547, p = 0.453).

Ranking of OHS Topics in the Order of Learning Interest Score

The OHS topics in each academic group with mean learning interest scores exceeding or equaling 2.57 (mean score for learning interest in all academic groups) were ranked by scores. As Table VI shows, life and health sciences, physical sciences, engineering, liberal arts, and social sciences included 25, 19, 21, 8, and 9 topics, respectively. Among those five academic groups, the most common topics of interest in the first 10 ranks included (1) emergency response, (2) fire protection, (3) personal protective equipment, (4) health management, (5) first aid, (6) biological hazards, (7) hazards of computer operations,

TABLE VI. Ranking of OHS Topics in the Order of Learning Interest Score Among Five Academic Groups

Rank	Overall	Life and Health Sciences	Physical Sciences	Engineering	Liberal Arts	Social Sciences
1	A	A	A	A	A	A
2	B	F	E	B	B	B
3	C	E	C	C	C	D
4	D	C	B	D	D	C
5	E	D	F	G	G	G
6	F	B	K	E	I	H
7	G	M	D	K	H	O
8	H	I	R	F	O	F
9	I	H	G	X		J
10	J	K	X	H		
11	K	P	P	L		
12	L	R	H	R		
13	M	J	S	J		
14	N	L	M	M		
15	O	N	I	W		
16		S	W	N		
17		G	N	P		
18		Q	J	U		
19		T	L	I		
20		U		S		
21		V		Z		
22		W				
23		X				
24		Y				
25		O				

A: Emergency response; B: Fire protection; C: Personal protective equipment; D: Health management; E: First aid; F: Biological hazards; G: Hazards of computer operations; H: Hazard communication; I: Respiratory protection; J: Analyzing and preventing accidents; K: Chemical hazards; L: Health risk assessment; M: Biological monitoring; N: Hazard control; O: Noise; P: Ionizing radiation; Q: Nonionizing radiation; R: Laboratory hazard identification; S: Labeling system of hazardous materials in laboratories; T: Exposure assessment; U: Ergonomics; V: Waste management of laboratories; W: Ventilation principles; X: Electricity safety; Y: Control of vibration; and Z: Machine safety.

(8) hazard communication, (9) respiratory protection, and (10) analyzing and preventing accidents.

DISCUSSION

This study analyzed the motivation of college students for taking OHS courses. The significant parameters associated with motivation to take OHS courses were former experience in OHS coursework, academic background, and learning interest in special topics. Learning interest in the addressed OHS topics varied with academic background.

Academic background and former experience in OHS coursework governed the interest in taking OHS courses if such a college course was offered. Respondents with academic backgrounds in life and health sciences, engineering, or physical sciences were more likely to indicate interest in taking OHS courses than students in liberal arts or social sciences. It is generally assumed that OHS elements are integrated into the natural science courses in biology, chemistry, and physics, so respondents may have been unaware that they had already received such training.

Conversely, students with academic backgrounds in liberal arts or social sciences have limited opportunities to receive OHS education in the Taiwan education system, natural sciences are not required courses after the first year of senior high school, which is equivalent to 10th grade in the U.S. education system. This course design therefore limits their opportunities to acquire OHS knowledge. Students may eventually consider OHS courses unnecessary because they were not offered in senior high school. Students with experience in health and safety-related coursework had a more favorable view of education in this area. If the inference is true, student interest could be stimulated by introducing OHS education along with basic scientific principles in the college curriculum or even early in the senior high school curriculum.

Such proactive education has been approved and executed in Alaska, where the state government has implemented the Job Hazard Recognition Program curriculum for high school students and graduate level university students.[2] In Taiwan, the authors recommend offering OHS at college level as a general education requirement, since general education courses are available to all college students regardless of academic background. The findings of the present study may

be useful in a model of proactive OHS general education and course development in Taiwan.

This survey also intended to identify the OHS topics that college students are interested in learning and the topics they do not understand. The 30 OHS topics were addressed simply because they have occurred in occupational health and safety training. The topics were listed on the questionnaire without elaborate description. The respondents may have had opinions about some of the occupation-related topics, such as emergency response, health management, and hazard communication and, therefore, may have had enhanced interest in these topics. However, most topics, such as fire protection, personal protective equipment, hazards of computer operations, respiratory protection, and chemical hazards, were generic and were probably not misinterpreted by the respondents.

Some OHS topics were categorized as high interest but low awareness in this study. Such topics included first aid, biological hazards, analyzing and preventing accidents, health risk assessment, biological monitoring, and hazard control. This group of topics was chosen as a learning priority by all academic groups of students except the liberal arts and social sciences students. Students in social sciences included only biological hazards and analyzing and preventing accidents in their priority lists (Table VI). This information, "which OHS topics college students would be interested in learning" and "which topics college students did not understand," provided an important basis for developing college level OHS course modules. Topics with high learning interest should be included in entry-level courses to encourage college students to take OHS courses.

Twelve topics were categorized as low learning interest and low awareness, probably because respondents were unfamiliar with some of the technical terms. For example, nonionizing radiation is a common occupational health and safety term but it is unfamiliar to the general population. In addition, the terms machine safety, construction safety, labeling system of hazardous materials in laboratories, waste management of laboratories, introduction to health and safety in laboratories, and laboratory safety laws and regulations may have been misinterpreted as professional majors. Thus, properly naming an OHS topic would meet student expectations and enhance learning interest. To avoid undermining student motivation to take OHS courses, topics with low learning interest and awareness may be integrated with other high-interest topics and should not be included until later stages of the course.

CONCLUSION

This study revealed that three key determinants: (1) experience in OHS coursework, (2) academic background, and (3) learning interest in OHS topics, significantly influence motivation to take OHS courses. Providing students with opportunities to explore occupational health and safety may help stimulate further OHS learning willingness

Ten core topics were ranked highest in learning interest by the survey respondents. Including these topics in a general safety and health course for college students would fulfill the original purpose of this survey. The survey also provides comparative data for students in different college majors and could provide a basis for devising a general occupational health and safety course for students in different disciplines.

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附件六

Title: Occupational Health and Safety Knowledge Improvement after an Intervention among Undergraduates

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Abstract

Occupational health and safety (OHS) education is essential for employee in workplace as well as the students in campus. In Taiwan, a 32–hour OHS course module was organized for undergraduates. The students' OHS knowledge improvement by this intervention was evaluated by a before and after study design without a control group between 2006 and 2007. A questionnaire contained 39 multiple choice questions was utilized to assess students' OHS knowledge of 13 topics, chemical hazards, hazard communication, biological hazards, ergonomic, hazards of computer operations, noise, ionizing radiation, nonionizing radiation, respiratory protection, personal protective equipment, electricity safety, fire protection and first aid. A total of 933 students who were enrolled in elective OHS classes at 18 colleges completed both pretest and posttest. Students' OHS knowledge improved significantly after this intervention. Though ergonomics and hazards of computer operations resulted in different improvements between nature sciences and social sciences groups, the overall content was still appropriate to most enrolled students. Content modification is recommended to enhance the learning efficacy for all undergraduates.

Key Words: Occupational health and safety education, Program effectiveness, Occupational health, Educational intervention

Biographical sketch

Yu-Huei Tong is a doctoral student of the Institute of Occupational Medicine & Industrial Hygiene, National Taiwan University, Taiwan. She received a master degree in environmental medicine in National Cheng Kung University and was an assistant researcher in Ministry of Education in Taiwan for three years. Her main research interests are industrial hygiene and occupational health and safety education.

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Yu-Wen Lin is an assistant professor in Department of Public Health, Fu-Jen Catholic University, College of Medicine, Taiwan. She received her Ph.D. degree from the industrial hygiene program of the Environmental Health Sciences Department, University of California, Los Angeles, School of Public Health. Dr. Lin has played a part in the course developments of the occupational safety and health training and education of Taiwan Council of Labor Affair and Ministry of Education. Her research also focuses on the evaluation of chemical protective clothing and exposure assessment.

1. **Introduction**

Safety and injury-prevention education has been addressed in school curricula. Various topics were assigned to different stages in the school education system. Vehicular safety, falls, burns, and avoidance of strangers were the focus issues at the elementary school level (Cook *et al*., 2006; Luria, Smith & Chapman, 2000; Hall-Lonh, Schell & Corrigan, 2001; Bull *et al*., 2006). Topics related to laboratory and job safety were included at the high school stage (Hild, 1992; Lerman *et al*., 1998; Wong *et al*., 2005; Martinez, Levine, Martin & Altman, 1993). Some colleges offered the occupational health and safety (OHS) courses or training programs to students that related to their majors or laboratory practices. The OHS curriculum discussion was concentrated on specific majors, such as chemistry, nurse and etc (Hill, 2003; Hill & Nelson, 2005; Talty &Walters, 1987; NIOSH, 2010; Wang *et al*., 2003). Few reports addressed in providing OHS education for all students (Hild, 1992; Lerman *et al*., 1998; Finn, 1978; Tong, Lin, Chen & Lin, 2009). Learning OHS at colleges could be a pre-employment training for college students.

Certain departments did pay attention to OHS education and training in their curricula. Students should be aware of the risk of using chemicals at the laboratory practices, especially for toxic chemicals. Therefore, the chemistry education emphasized the students' OHS education (Hill, 2003; Hill & Nelson, 2005). The need of chemical safety knowledge for hairdressing students was discussed as well (Wong *et al*., 2005). The OHS education for student nurses was needed to avoid the needle stick and bloodborne pathogens (Wang *et al*., 2003). The U.S. National Institute for Occupational Safety and Health (NIOSH) formed two educational projects, Minerva for business schools and Safety and Health Awareness for Preventive Engineering (SHAPE) for engineering schools, to promote health and safety education (Talty &Walters, 1987). SHAPE developed nine instructional modules to assist the engineering faculty who intends to incorporate occupational safety and health topics within

appropriate required and elective courses (NIOSH, 2010).

Providing OHS education to all students was also discussed. One success program was including an OHS curriculum to non–vocational high school courses in Alaska (Hild, 1992). In Israel, an occupational health education program for high school students was developed in 1998. The effectiveness of the program proofed the occupational health learning can be occurred successfully in high school (Lerman *et al*., 1998). All these studies demonstrated a feasible opportunity to teach students the OHS knowledge with applicable contexts for students regardless of their educational background.

In Taiwan, an OHS education program, tailoring basic OHS knowledge as a 2-unit undergraduate course, was developed in 2004. This OHS general education intended to teach undergraduate students with different majors, including nature sciences and social sciences, be able to know those stressors and inappropriate behaviors would be risk in both daily life and workplace from the safety and health points of view. The course includes 16 OHS topics which were decided by a national survey for college students and OHS professionals (Tong, Lin, Chen & Lin, 2009). Part or all of the topics could be integrated to the course curriculum by instructors. Thirteen topics (chemical hazards, hazard communication, biological hazards, respiratory protection, personal protective equipment, noise, ionizing radiation, nonionizing radiation, ergonomics, hazards of computer operations, electricity safety, fire protection and first aid) were included to assess the effectiveness of this course intervention. A before and after study design without a control group and a self evaluation questionnaire was used to measure the impacts of the intervention (a two-unit OHS general education course) on students' OHS knowledge. The influents of student majors on the intervention outcome were also investigated to evaluate the suability of the course context for all undergraduate students.

2. Subjects and Methods

2.1 Study design and study population

In 2006 and 2007, a total of 933 students who were enrolled in OHS general courses at 18 colleges in north Taiwan completed the questionnaire before and after the course session immediately. Each selected topic was conducted as a two–hour lecture within the same semester.

2.2 Questionnaire

A questionnaire was developed to assess the student OHS knowledge improvement by this educational program. The evaluation questionnaire consisted of two parts. The first part was the basic demographic information including school, name, student ID number, major and class rank. Three questions were compiled from each topic resulted in a total of 39 questions as the second part of the questionnaire to evaluate students' OHS knowledge. One point attributed to each correct answer. The total score of the second part was calculated by adding up the points and dividing by 39. The sub-score of each topic was also calculated by adding up the point and dividing by 3. The questionnaire used the peer-review to affirm the content validity. It would take around 20 minutes for student to complete the questionnaire. None of the information that students delivered in this questionnaire were counted as part of his/her official grade of this course. Students were notified for this message before they filled out the questionnaire.

2.3 Statistical analysis

Paired-t test was utilized to examine the differences between pretest and posttest. Student t-test was used to compare the pretest scores of OHS knowledge between nature sciences group and social sciences group. Linear regression models were applied to illustrate the associations of respondents' OHS knowledge improvements in relation to two academic groups (nature sciences *vs*. social sciences) after the intervention as a surrogate indicator of the content appropriateness. Class rank and pretest score were defined as confounding factors

and were controlled during the modeling process. The level of significance was set to $\alpha < 0.01$ to minimize Type I error. Statistical analyses were performed by SPSS version 12.0 (SPSS Inc., Chicago, IL, USA).

3. Results

3.1 Sample Demographic Data

The majority of respondents were juniors (401/933) comprising 43% of the total respondents, while freshmen, sophomores and seniors comprised 15%, 22% and 20%, respectively (Table 1). About 70% of the respondents belonged to the nature sciences group which meant their majors were either life and health sciences or engineering. The other 30% of the respondents were classified as social sciences group for those who majored in liberal arts and social sciences.

3.2 Baseline Information

The pretest mean score of 13 topics of all students was 0.60±0.10 (Table 1). No single student achieved correct answers in all 39 questions. The baseline mean score (pretest) of OHS knowledge of the nature sciences group students was slightly higher than that of social sciences group (0.60 *vs*. 0.59) (Table 1). While comparing the baselines scores of the students from different class ranks, the highest one was 0.62 of seniors and the lowest one was 0.58 of sophomores.

Table 2 lists the mean sub-scores of pretest and posttest of each topic. Students demonstrated pretty good knowledge of chemical hazards, biological hazards, ergonomics, and electricity safety with the pretest mean sub-scores exceeding 0.70. The highest mean sub-score was 0.82 for electricity safety. However, they obtained low scores in ionizing radiation (mean 0.35), nonionizing radiation (mean 0.38) and hazards of computer operations (mean 0.30) in pretest. It seems students' knowledge of these topics were deficiency. Three

topics, chemical hazards, hazard communication and electricity safety showed significant differences at the baseline between nature sciences group and social sciences group (Table 3).

3.3 Change of the OHS knowledge

The significant improvement in overall OHS knowledge was observed (mean scores from 0.60 to 0.67, $p < 0.001$) after the OHS education intervention (Table 1). The posttest mean sub-scores of each topic were significantly higher than the pretest ones. The only exception was electricity safety which students had done well at the pretest (0.82±0.21) (Table 2). The posttest mean scores of four class ranks and two academic groups showed significantly better than pretest scores (Table 1).

Both nature sciences and social sciences groups significantly improved on OHS knowledge for all topics except electricity safety after OHS course (Table 3). As being evident from the linear regression models, there was significantly different intervention effects between two academic groups in ergonomics ($\beta = 0.047$, $p = 0.002$) and hazards of computer operations ($\beta = 0.049$, $p = 0.004$) (Table 3). The nature sciences students learned better than social sciences students did in these two topics.

4. Discussion

The study results in a positive impact on OHS knowledge of college students via the OHS general education intervention. The finding was consistent with other peer school-based studies on OHS knowledge improvement after education interventions for high school students and student nurses (Lerman *et al*., 1998; Wang *et al*., 2003). The significant improvement of students OHS knowledge also demonstrated the success of the OHS general course design. The course content included applicable examples and experiences from daily life and workplace. Lecturers focused on providing factual information of basic OHS, including recognizing hazard symbols of hazardous materials, selecting and wearing PPE

correctly, revealing myth such as “any mask has protection effect” to guide students to navigate the unfamiliar and complex OHS context.

To design an appropriate OHS content to all students was the ultimate goal as well as a challenge for this course development. Nature sciences group and social sciences group showed a small difference of OHS knowledge background according to the pretest results (0.60 *vs*. 0.59). Both academic groups presented significant improvement after the course intervention. It implied the course design overcame the challenge. Two academic groups showed significantly different pretest mean sub–scores of chemical hazards, hazard communication, and electricity safety. However, both groups improved significantly in chemical hazards and hazard communication according to the posttest mean sub–scores (Table 3). It was noteworthy that different academic background did not affect the improvement by the regression analyses results excepting two topics – ergonomics and hazards of computer operations (Table 3). There was no way to rule out the differences between groups for these particular two topics according to the present questionnaire-based study. Particularly, ergonomics is a combined domain of engineering, biomechanics, physiology, psychology and anatomy, so that the nature sciences students shall be able to catch the concept better. The other topic, hazards of computer operations, was actually the ergonomic issues focusing on the computer operation situations. So, both might result in similar learning differences between two groups. More study is needed to verify the reasons.

The electricity safety was the only topic with no improvement after the intervention (Table 2).The possible reason was electricity safety knowledge was familiar as electricity being unavoidable with people’s daily life. In Taiwan, students started learning the electricity safety knowledge since elementary school, so the major context of this topic would be straightforward for most of the college students (pretest mean score = 0.82). Students admitted this topic as high awareness but low learning interests in the previous survey (Tong,

Lin, Chen & Lin, 2009); this agreed with the results of pretest and posttest in this study. Keeping this topic in this course would be just a refresh purpose. Replacement of this topic or upgrading the content of this particular topic shall be considered if the course content would be modified in the future.

The great improvements of ionizing radiation and nonionizing radiation delivered an important message. According to the previous study of course developing process [15)], college students who were never enrolled in any OHS course expressed low learning interest and low awareness of ionizing radiation and nonionizing radiation. In this study, the good learning performance demonstrated that low learning interest might due to unfriendly professional terminologies and insufficiency radiation knowledge. Once students were explored to the course contents rather than just a technical subject tittle, they were willing to learn and capable of great enhancements, as the scores increased from 0.35 to 0.49 for ionization radiation and from 0.38 to 0.47 for nonionizing radiation, respectively (Table 2).

The different proportions of students' background (70% *vs*. 30%) were expected. Student's academic background was a key factor of their motivation to take OHS courses (Tong, Lin, Chen & Lin, 2009). Students with natural sciences or engineering backgrounds had more interest in taking OHS courses than those with other academic backgrounds.

No follow-up test was one limitation of this study because education interventions showed the positive influence initially might or not keep the intensity over time (Hall-Lonh, Schell & Corrigan, 2001; Bull *et al*, 2006; Wong *et al*, 2005; Martinez, Levine, Martin & Altman, 1993). This limitation was due to the nature character of the general courses. Students who were enrolled to the same general course actually came from different majors and class ranks. It would be almost unfeasible to those students for follow-up test after the course completion. Furthermore, the positive impact on knowledge of the course was just the beginning of OHS aims, as knowledge change was the initiation of behavior change. Wang *et al*. suggested that

sufficient chemical-safety knowledge affected participants' intentions to practice safe chemical-handling behavior while handling such chemicals (Wang *et al*., 2003). More studies regarding the course influence on attitude and behavior shall be investigated. The other limitation of this study was lack of control groups. The evaluations were performed in 18 colleges, therefore establishing a parallel comparable control group from other general education course in each college was impracticable.

Teaching how to have healthy life and prevent injuries shall always be part of school education. Therefore, providing more useful related courses for students shall never be over emphasized. Offering general OHS education at college level is recommended because there is a captive audience of young adults and a forum in which many of them can be reached at one time. This OHS course opened a window to the young adult to learn and assure certain OHS knowledge that was misunderstood or unknown before. Through this window, students will learn the basic scopes of OHS and initiate their learning interest in OHS.

5. Impact on Industry

Giving students the opportunities to explore OHS shall be an import seeding for further OHS training at workplace after their completion of school education if this OHS education program could be admitted and offered constantly in colleges.

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Table 1. The pretest and posttest mean scores of class ranks and academic groups

	N (%)	Mean Score (Mean ± SD)		Paired t	*p*-Value
		Pretest	Posttest		
	933(100%)	0.60±0.10	0.67±0.12	18.831	<0.001
Class Rank					
Freshman (1)	136 (14.6)	0.59±0.11	0.63±0.13	3.763	<0.001
Sophomore (2)	209 (22.4)	0.58±0.10	0.64±0.11	7.577	<0.001
Junior (3)	401 (43.0)	0.60±0.09	0.67±0.12	12.576	<0.001
Senior (4)	187 (20.0)	0.62±0.09	0.72±0.12	12.844	<0.001
Academic Group					
Nature sciences	653 (70.2)	0.60±0.10	0.68±0.12	17.113	<0.001
Social sciences	277 (29.8)	0.59±0.09	0.65±0.13	8.350	<0.001

Abbreviations: number (N); standard deviation(SD)

Table 2. The pretest and posttest mean sub-scores of each OHS topic (n=933)

OSH Topic	Mean Sub–Score (Mean±SD)		Paired t	*p*-Value
	Pretest	Posttest		
Chemical hazards	0.75±0.25	0.80±0.25	6.042	<0.001
Hazard communication	0.56±0.25	0.64±0.25	8.103	<0.001
Biological hazards	0.77±0.25	0.82±0.26	5.301	<0.001
Noise	0.59±0.26	0.64±0.27	5.395	<0.001
Ionizing radiation	0.35±0.17	0.49±0.26	15.619	<0.001
Nonionizing radiation	0.38±0.25	0.47±0.28	7.544	<0.001
Personal protective equipment	0.65±0.24	0.70±0.21	5.535	<0.001
Respiratory protection	0.57±0.29	0.67±0.30	8.276	<0.001
Ergonomics	0.77±0.23	0.85±0.21	8.626	<0.001
Hazards of computer operations	0.30±0.24	0.37±0.24	7.828	<0.001
Fire protection	0.56±0.30	0.65±0.30	5.140	<0.001
Electricity safety	0.82±0.21	0.82±0.21	0.603	0.55
First aid	0.56±0.30	0.65±0.30	8.030	<0.001

Abbreviations: standard deviation(SD)

Table 3. Student t-test and regression analyses of OSH knowledge changes between academic groups of each topic (n=930)

OHS Topic	Academic group	Pretest Sub-score t–Test (t, *p*-Value)	Posttest Sub-score	Paired t	*p*-Value	Regression [a] β±S.E.	*p*-Value
Chemical hazards	Nature sciences	0.77±0.24	0.81±0.23	4.64	<0.001*	0.019±0.015	0.207
	Social sciences	0.70±0.24	0.76±0.25	3.89	<0.001*	1	
		(t=3.92, p<0.001*)					
Hazard communication	Nature sciences	0.57±0.25	0.65±0.25	6.46	<0.001*	0.032±0.018	0.074
	Social sciences	0.52±0.24	0.61±0.25	4.83	<0.001*	1	
		(t=2.96, *p*=0.003*)					
Biological hazards	Nature sciences	0.77±0.26	0.82±0.22	4.66	<0.001*	0.012±0.016	0.436
	Social sciences	0.76±0.24	0.81±0.24	2.49	0.013*	1	
		(t=0.29, *p*=0.770)					
Noise	Nature sciences	0.60±0.26	0.64±0.25	4.10	<0.001*	0.008±0.017	0.617
	Social sciences	0.56±0.26	0.62±0.27	3.41	0.001*	1	

		(t=2.03, *p*=0.042)					
Ionizing radiation	Nature sciences	0.35±0.18	0.49±0.27	13.11	<0.001*	0.013±0.018	0.493
	Social sciences	0.34±0.15	0.47±0.25	8.46	<0.001*	1	
		(t=0.64, *p*=0.521)					
Nonionizing radiation	Nature sciences	0.39±0.26	0.48±0.29	7.11	<0.001*	0.045±0.020	0.023
	Social sciences	0.38±0.23	0.43±0.27	2.90	0.004*	1	
		(t=0.51, *p*=0.614)					
Personal protective equipment	Nature sciences	0.65±0.24	0.71±0.22	5.31	<0.001*	0.025±0.015	0.113
	Social sciences	0.66±0.23	0.69±0.22	1.79	0.075	1	
		(t=-0.50, *p*=0.620)					
Respiratory protection	Natural sciences	0.57±0.29	0.66±0.30	6.63	<0.001*	0.001±0.020	0.946
	Social sciences	0.56±0.28	0.66±0.29	4.90	<0.001*	1	
		(t=0.75, *p*=0.451)					
Ergonomics	Nature sciences	0.77±0.23	0.86±0.20	8.49	<0.001*	0.047±0.015	0.002*

	Social sciences	0.76±0.23	0.82±0.24	2.96	0.003*	1	
		(t=0.71, *p*=0.478)					
Hazards of	Nature sciences	0.30±0.24	0.40±0.24	7.68	<0.001*	0.049±0.017	0.004*
computer	Social sciences	0.30±0.24	0.34±0.24	2.25	0.025*	1	
operations		(t=-0.25, *p*=0.805)					
Fire	Nature sciences	0.74±0.24	0.79±0.23	4.56	<0.001*	0.036±0.017	0.033
protection	Social sciences	0.71±0.24	0.75±0.24	2.36	0.019*	1	
		(t=1.59, *p*=0.112)					
Electricity	Nature sciences	0.83±0.20	0.83±0.21	-0.05	0.96	0.017±0.014	0.235
safety	Social sciences	0.79±0.21	0.80±0.21	1.14	0.25	1	
		(t=3.15, *p*=0.002*)					
First aid	Nature sciences	0.55±0.30	0.64±0.30	6.57	<0.001*	-0.027±0.021	0.196
	Social sciences	0.58±0.30	0.67±0.30	4.44	<0.001*	1	
		(t=-1.41, *p*=0.158)					

Notes:* *p*-Value < 0.01

[a]: regression model adjusted by class rank and pretest score.

Abbreviations: standard error(S.E.)

附件七

Journal of American COLLEGE HEALTH

The impact of an occupational health and safety course on knowledge, attitude and behavioral intention among college students

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The impact of an occupational health and safety course on knowledge, attitude and behavioral intention among college students

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ABSTRACT

Objective: The impacts of the occupational health and safety (OHS) course on undergraduates' knowledge, attitude, self-efficacy and behavior intention were evaluated. **Participants:** Participants were 205 college students (107 for intervention and 98 for control) from 2 universities. **Methods:** The intervention was assessed by a quasi-experimental, nonequivalent control group design with pre-post-follow-up tests. T-test was applied for the differences in mean scores. The explanatory factors of the intervention were identified by generalized estimating equation regression models. **Results:** Statistically higher mean scores of knowledge (from 0.49 to 0.65), attitude (from 2.83 to 3.00), and behavioral intention (from 3.01 to 3.06) were observed for intervention group after intervention and the significant improvements kept till follow–up. The regression models indicated the intervention positively changed the knowledge and safety practices. **Conclusions:** Offering OHS courses constantly among colleges is recommended as the great positively impact proofed by this study.

Key Words: occupational health and safety education; OHS attitude; OHS self-efficacy; OHS behavioral-intention; program evaluation

The occupational health and safety (OHS) education programs have been developed but few for undergraduate setting. General speaking, the OHS education are used to focus on the on-site workplace trainings and the professional developments of OHS specialists. There were some discussions about curricula of professional OHS major [1–4] and OHS curriculum need of specific majors in schools [5–8], but limited reports addressed in providing OHS education to all students. [9–14] To provide the OHS information to the students at schools, before the career initiation shall be important. [13, 14]

The U. S. National Institute for Occupational Safety and Health (NIOSH) initiated two school-based educational projects concerning OHS issues: Minerva for business schools and Safety and Health Awareness for Preventive Engineering (SHAPE) for engineering schools. [10] Nine course modules of SHAPE were available on-line which allowed the engineering instructors to include the occupational health and safety materials in the professional courses. [11] Hild successfully integrated an OHS curriculum into Alaska non-vocational high school courses. [12] The knowledge, attitude and beliefs of the Israel high school students were improved after the intervention of occupational health education program. [13] In China, student nurses improved the knowledge and behavior in prevention of occupational exposure to bloodborne pathogens after structured training. [6] The feasibilities and efficacy in delivering the OHS knowledge to students of different majors and settings were demonstrated by those peer's studies.

Offering general OHS courses to college students was proposed in Taiwan. A two-unit OHS course curriculum was organized in 2004. The course materials contained 16 OHS topics which were decided based on a national wide survey in 2004. [14] Eight topics (chemical hazards, hazard communication, biological hazards, respiratory protection, personal

protective equipment, noise, ionizing radiation and nonionizing radiation) were included to evaluate the short-term and long-term effectiveness of the OHS course. A nonequivalent pretest–posttest control group design and a self-reported questionnaire was used to measure the impacts of the intervention on students' knowledge, attitude, self-efficacy and behavior intention which instead of the behavior change observed.

METHODS

Participants

The intervention program was conducted parallel at two universities in spring semester, 2008. The intervention group was composed of the enrolled students from two identical OHS general courses of these two universities, with 54 and 53 students respectively. The control group was the students who were enrolled in the other two different general education courses, both with 49 students.

Procedure

The evaluation of the OHS general course was carried out by an experimental model using intervention and control groups. It was a longitudinal study with a before-and-after plus follow-up test design. The pretest and posttest evaluated the intervention impacts. The follow-up test was performed in five weeks after the posttest to assess the persistence of the intervention. Both intervention and control groups participated all three tests. The selected OHS topics were completed in consecutive eight weeks. Each topic was lectured for two hours. The lecture sequences and lecturers of two intervention classes were identical.

Measures

The evaluation questionnaire included five parts. The first part was the demographic

information consisting of gender, major, years of schooling, experience in OHS course, working status, and part-time job experiences. Additional five questions regarding the life experiences of OHS were also included in this part. The questions were: “have you ever attended any OHS training from the employers?”, “have you been injured in the workplace?”, “have your relatives or friends ever been injured or had accidents in the work place?”, “are any of your family members whose job title related to health and safety professional (such as CIH, CSP, and etc.)?” and “are you aware of the term “Occupational Health and Safety” before this course?”. The second part was composed of 23 multiple choice questions to assess the OHS knowledge which focused on the key learning points of the course content. Each correct answer was counted as 1 point. Score of the second part was calculated by adding up the points and dividing by 23.

The OHS attitude, self-efficacy and behavioral intention were measured in the other three parts of the questionnaire. The attitude was evaluated by four categories: general safety perception, specific safety perception, general safety practice and specific safety practice. The specific safety perception and practice questions were designed based on the course content. For example, the item “the workplace health and safety regulations and managements are not helpful in decreasing the incidences of accidents” was for general safety perception and the item “I agree that everyone should understand the warning labels of chemicals” was for specific safety perception from the hazard communication lecture. “I will follow the safety regulations and the standard operation procedures at work” was for general safety practice and “I am able to select the appropriate personal protection equipments when they are needed” was for specific safety practice. Each category contained 6 to 13 questions with the Likert five-point scale with the attributed point in the parentheses – strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5).

The self-efficacy were asked students to judge their own certainty of capability, such as "I am sure that I can tolerate the uncomfortable feeling while wearing the personal protection equipments especially under the hot working environment", also by the Likert five-point scale from "extraordinary not sure" to "definitely sure". To evaluate the OHS behavioral intention of the students, five questions were designed to assess their willingness to practice certain safety behaviors in the future workplace. "I will follow the workplace health and safety regulations in the future" was one of the questions. The Likert four-point scale, "definitely no", "probably not", "probably yes" and "definitely yes" was the degree for self evaluation.

The questionnaire was peer-reviewed to affirm the content validity. Item difficulty analysis methods were utilized to evaluate the reliabilities of the each parts of this questionnaire. For OHS knowledge, the reliability of the multiple choice question was assessed by discrimination and difficulty. The questions should fit the criteria with the item discrimination index not less than 0.2 and the difficulty index between 0.4 and 0.8. [15] The inner consistency was applied to assess the reliabilities of the other three parts with the coefficient of Cronbach α exceeding 0.7. The reliability analysis was based on the result of a pilot test including 223 students who were enrolled the OHS general courses in the fall semester, 2007. Finally, 23 questions were included. The Cronbach α values were 0.82 for the general safety perception, 0.83 for specific safety perception, 0.88 for general safety practice, 0.88 for specific safety practice, 0.83 for OHS self-efficacy, and 0.78 for OHS behavioral intention.

Data Analysis

Pearson chi-square tests were applied to verify the homogeneousness of the participants' demographic characteristics between intervention and control groups. Student *t*-tests were used to compare the baseline (pretest) of OHS knowledge, attitude, self-efficacy and behavioral intention between the two groups. Paired *t*-tests were utilized to examine the differences between each two tests. Generalized estimating equation (GEE) regression models were used to illustrate the associations of respondents' OHS knowledge, attitude and behavioral intention in relation to two groups (intervention *vs*. control) and three tests (pretest, posttest and follow-up test). Gender, academic groups (liberal arts, social sciences, life and health sciences and nature sciences), years of schooling, part-time job experience, OHS training from part-time job employer, and family members work as OHS profession were defined as confounding factors. Interaction term between two groups and three tests were also included in the models to calculate adjusted scores. The level of significance was set to $\alpha < 0.05$. Statistical analyses were performed by SPSS version 12.0 (SPSS Inc., Chicago, IL, USA) and SAS version 8.2 (SAS Institute Inc., Cary, NC, USA).

RESULTS

Sample demographic data

The demographic characteristics including 106 respondents from the intervention group and 91 from the control group at the pretest are described in Table 1. Respondents were eliminated for data analysis due to the absence on the days of the posttest or the follow-up test. In total, 62 students in the intervention group and 62 students in the control group completed the three tests. The gender ratios (female/male) of two groups were similar, which was 1.8 for the intervention group and 1.5 for the control group. Sophomores were the majority as comprised 47% of the total respondents while freshmen, juniors and seniors comprised 15%, 17% and 21%, accordingly. The distribution of years of schooling between

the two groups significantly differed ($\chi^2 = 21.406$, df = 3, $p < 0.001$). Forty-four percent of the respondents majored in social sciences, and respondents majored in liberal arts, life and health sciences and nature sciences comprised 22%, 12% and 22%, accordingly. More students of the intervention group had part-time job experiences than the students of control group did (82% *vs*. 68%, $\chi^2 = 5.212$, df = 1, $p = 0.03$). The other characteristics were not significantly different between the groups. The statistical adjustments for years of schooling and part-time job experience were counted in GEE regression model analyses.

Baseline information

The study found an intermediate level of baseline knowledge regarding OHS among college students according to the results of pretest (Table 2). In average, 53.8% students responded correctly on more than half of the questions. No student correctly answered all 23 questions. The pretest results implied the insufficient knowledge on chemical hazards (mean score 0.27), nonionizing radiation (mean score 0.38) and biological hazards (mean score 0.45). Nevertheless, the highest means score was 0.71 for the personal protective equipment (Table 2). Students' baseline levels of OHS knowledge, attitudes, self-efficacy and behavioral intention had no significant differences between intervention and control groups. Neither years of schooling nor part-time job experience had significant effect on the baseline knowledge, attitudes, self-efficacy and behavioral intentions.

All participants' attitude toward OHS was moderately positive (mean scores ranged from 3.45 to 4.17 of a possible score of 5) at the baseline level. Only the mean score of specific safety practice (3.44) was less than 3.5. Indeed, less than 20% of the students checked "disagree" or "strongly disagree" for the items of OHS attitude. The percentages of these two negative selections were between 0.1% and 19.3%.

The mean score of respondents' self-efficacy was 3.75 of a possible score of 5 at the baseline. The lowest self-efficacy score was the statement "I am sure that I can tolerate the uncomfortable feeling while wearing the personal protection equipments especially under the hot working environment" (mean score 3.34) with 43.3% students reporting their confidence to stand for this uncomfortable situation.

Baseline behavioral intentions indicated more than 90% of the students were willing to follow the workplace health and safety regulations (96%), help others to avoid injuries in workplaces (90.6%), share OHS knowledge with their family and friends (90.5%). About 83.2% of the students will attend the health and safety training in workplaces in the future and the smallest proportion (70.8%) expressed the willing to collect related information for health and safety regulations and OHS case studies in the future.

Change of the OHS knowledge

Table 3 presents the mean scores of pretest, posttest and follow-up test on OHS knowledge of both groups with the pair-*t* test comparisons. After the intervention, the significant improvements in OHS knowledge were observed in the intervention group, the mean scores from 0.49 for pretest to 0.65 for posttest. Statistically, the intervention program had great impacts on the knowledge regarding chemical hazards, hazard communication, ionizing radiation, personal protective equipment, and nonionizing radiation. No significant difference between pretest (0.51) and posttest (0.54) was observed for control group.

Change of the OHS attitude, self–efficacy and behavioral intention

The mean scores of OHS attitude, self-efficacy and behavioral intention at pretest,

posttest and follow-up test are shown in Table 4. The intervention group showed a positive change in attitude and behavioral intention but not in self-efficacy after the intervention. Significant improvements on general safety practice and specific safety practice were observed after the intervention (3.90 *vs*. 4.08, p = 0.01 and 3.36 *vs*. 3.71, $p < 0.001$). All six items of general safety practice were improved at posttest ($p = 0.4 – 0.004$), and the biggest improvement was "I will report to the safety personnel as soon as possible when the environment is dangerous" (from 3.82 to 4.08, $p = 0.004$). The specific safety practice also significantly increased at posttest except the statements – "I always wear a mask when I have the flu to avoid spreading virus" and "I am willing to reduce the duration of cellular phone usage." The item, "wear earplug correctly", had the greatest positive change (from 3.15 to 3.79, $p < 0.001$). In control group, no significant changes for all aspects except a significant improvement for general safety practice at posttest.

Explanatory Factor Analyses by GEE Regression Models

The results of GEE regression models confirmed the contributions of intervention group ($\beta = 0.066$, $p < 0.001$) and test itself ($\beta = 0.092$, $p < 0.001$ as posttest; $\beta = 0.087$, $p < 0.001$ as follow–up test) in the knowledge improvements (Table 5). The interaction between group and test affected the knowledge scores for intervention group ($\beta = 0.097$, $p < 0.001$ as posttest; $\beta = 0.114$, $p < 0.001$ as follow-up test), as Figure 1. Test itself significantly affected the general safety practice ($\beta = 0.206$, $p < 0.001$ as posttest; $\beta = 0.173$, $p < 0.001$ as follow-up test), the specific safety practice ($\beta = 0.207$, $p < 0.001$ as posttest; $\beta = 0.253$, $p < 0.001$ as follow-up test), and the behavioral intention ($\beta = 0.118$, $p = 0.01$ as follow-up test) (Table 5). The intervention only significantly influenced the specific safety practice ($\beta = 0.134$, $p = 0.04$). The interaction effect of groups and tests on specific safety practice ($\beta = 0.283$, $p < 0.001$ as posttest; $\beta = 0.318$, $p < 0.001$ as follow–up test) and behavioral intention ($\beta = 0.190$, $p = 0.02$

as follow-up test) in intervention group were also significant, as illustrating in Figures 2 and 3.

COMMENT

About 50% of the participated undergraduate students did not correctly answer the knowledge questions before the intervention program (both intervention and control group). The control group remained the low correct answer rate after intervention program. This level of ignorance supports the argument that occupational health and safety education at colleges is important and relevant. In Taiwan, this OHS course was offered at college level without any prerequisites. Lerman and associate [13] suggested the OHS education at high school setting, which is even one-step before the present recommendation program. This present study demonstrated the positive influence of the OHS educational intervention for college students in Taiwan. Participants of the intervention group reported statistically better OHS knowledge, more positive attitudes toward specific safety practice and behavioral intention than the participants in the control group did at posttest and follow-up test. Previous school-based studies also demonstrated the positive impacts on the students who attended the related health courses or training. [6, 13]

Due to the program design or the limitation of research process, education interventions showed the positive influence initially might or not keep the intensity eventually. [7, 16-18] The course design of this education intervention program was to simulate the learning intention by relating the OHS issues to students' daily life regardless their majors. This shall lead a feasible way to initiate and enhance students' learning effectiveness. During the lectures, teaching effort was focused on providing factual information about OHS, including erroneous beliefs such as "all masks can provide same protection" and myths of safety behavioral

intention as "I know the meaning of the warning symbols of hazardous materials". Classroom activities such as demonstrating how to wear PPE correctly were also included. The significantly improvements of OHS knowledge, attitude (especially specific safety practice), and behavioral intention in the posttest and follow–up test confirmed the success of this intervention design.

Showing a major positive impact at follow-up test and a minor positive impact at posttest, the behavioral intention seemed to present a different trend comparing with knowledge and attitude. Knowledge and attitude were able to be altered instantly after intervention and might be kept or decreased slightly at follow-up. But the improvement of behavioral intention was time-consuming. Knowledge, attitude and behavior affect each other. In general, the change of knowledge could be measured at first, attitude was the second and behavior change was the last one. It was not easy to identify the main factor that sustained the growing of behavioral intention after intervention. The possible influence to the students was the lecture did remind them to pay attention on health and safety issues. Actually, students in intervention group continued the OHS general course for other topics after the posttest, the lectures shall also inspire students to care health and safety issues more. Further study would be needed to clarify this particular improving trend of behavioral intention.

Answering questionnaire repeatedly (posttest *vs*. pretest) was positively related to the improvements of OHS knowledge and general safety practice. Questionnaire itself was one kind of information and would be a bias for the evaluation. Repeat information still contributed on knowledge learning ($\beta = 0.040$, $p = 0.005$) and general safety practice ($\beta = 0.204$, $p = 0.001$) change after the adjustment. It might imply that refreshment learning in OHS education or training process was a necessary way to enhance the learning performance.

Limitations

Certain limitations exited for this study. First, because of the self-reported nature, the integrity of respondents might be questioned. However, the confidentiality of the responses should have encouraged accurate self–disclosure. Second, long follow-up duration would be better. However, it is almost impracticable to perform the follow-up test after the curriculum end, such as in next semester, as the enrolled students becoming infeasible. Third, there was lack of safety behavior change observation. This OHS general course was a lecture-based design and the behavioral intention items were used instead of behavior observation. Future studies measuring the effects of this curriculum on observed behaviors might be needed to assess the core intention of OHS – acting safely.

Conclusion

Colleges may serve as the portal of knowledge entrance in occupational health, and tomorrow's graduates will and should demand more related OHS training form their workplaces. The present study demonstrated the program's effectiveness in achieving desired changes in the targeted mediators, namely knowledge, attitude, and behavioral intention, among college students in different elements of occupational health and safety. One of the chief features of this program is that it gives youth awareness of the elements in the workplace or daily life that could be risk to health and they can do some control to make their world healthier though their own behaviors and choices. The OHS general education program should therefore be offered constantly for all undergraduate students. Giving students more opportunities to explore OHS might be beneficial to the effectiveness of the future OHS training at workplace after graduation.

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TABLE 1. Demographic characteristics of study population

	N (%)				
	All	**Intervention group**	**Control group**	χ^2	***p*-Value**
Gender					
Male	75 (38)	38 (36)	37 (41)	0.481	0.56
Female	122 (62)	68 (64)	54 (59)		
Years of schooling					
Freshman (1)	30 (15)	18 (17)	12 (13)	21.406*	<0.001
Sophomore (2)	93 (47)	39 (36)	54 (59)		
Junior (3)	33 (17)	15 (14)	18 (20)		
Senior (4)	42 (21)	35 (33)	7 (8)		
Academic group					
Liberal arts	44 (22)	24 (22)	20 (22)	2.073	0.56
Social science	88 (44)	51 (48)	37 (41)		
Life and health science	24 (12)	10 (9)	14 (15)		
Nature science	42 (22)	22 (21)	20 (22)		
Having a part–time job					
Yes	147 (75)	86 (82)	61 (68)	5.212*	0.03
No	48 (25)	19 (18)	29 (32)		
OHS training from the part-time job employers					
Yes	28 (19)	13 (15)	15 (25)	2.077	0.20
No	119 (81)	73 (85)	46 (75)		
Injuries at the part–time workplace					
Yes	47 (32)	31 (36)	16 (27)	1.424	0.28

No	99 (6)	55 (64)	44 (73)		
Family members with job-related injuries					
Yes	49 (26)	28 (27)	21 (23)	0.589	0.75
No	78 (40)	42 (41)	36 (40)		
No idea	66 (34)	33 (32)	33 (37)		
Family members work as OHS profession					
Yes	6 (3)	6 (6)	0 (0)	5.408	0.07
No	153 (78)	81 (77)	72 (80)		
No idea	36 (19)	18 (17)	18 (20)		
Ever heard OHS term before this course					
Yes	140 (72)	77(73)	63 (71)	0.156	0.75
No	54 (28)	28(37)	26 (29)		

360 * *p*-Value < 0.05

TABLE 2. The OHS baselines of intervention and control groups

OHS Aspect	Mean scores, Mean±SD (n) Intervention group	Control group	t	*p*-Value
Knowledge				
Total	0.50±0.12 (107)	0.49±0.12 (91)	0.557	0.58
Chemical hazards	0.30±0.29 (106)	0.24±0.26 (91)	1.557	0.12
Hazard communication	0.58±0.27 (106)	0.58±0.29 (90)	-0.150	0.88
Ionizing radiation	0.55±0.24 (107)	0.58±0.25 (89)	-0.901	0.37
Respiratory protection	0.64±0.27 (107)	0.65±0.30 (90)	-0.271	0.79
Personal protective equipment	0.73±0.33 (107)	0.68±0.32 (90)	1.096	0.27
Noise	0.49±0.29 (106)	0.50±0.32 (90)	-0.326	0.75
Non–ionizing radiation	0.38±0.27 (106)	0.38±0.25 (90)	0.038	0.97
Biological hazards	0.45±0.31 (106)	0.45±0.31 (90)	-0.119	0.91
Attitude				
General safety perception	4.16±0.45 (107)	4.17±0.53 (91)	-0.075	0.94
Specific safety perception	4.02±0.38 (107)	4.03±0.45 (91)	-0.086	0.93
General safety practice	3.93±0.45 (107)	3.96±0.54 (90)	-0.436	0.66
Specific safety practice	3.42±0.47 (107)	3.47±0.46 (90)	-0.853	0.40
Self–efficacy	3.76±0.72 (107)	3.74±0.64 (90)	0.229	0.82
Behavioral intention	3.05±0.41 (105)	3.01±0.36 (90)	0.757	0.45

TABLE 3. OHS knowledge improvements of the intervention and control groups

Group (n)	Topics	Mean Score, mean±SD			Pair–t (*p*–Value)		
		Pretest	Posttest	Follow-up test	Pre *vs*. Post	Pre *vs*. Follow-up	Post *vs*. Follow-up
Intervention	**Total**	**0.49±0.12**	**0.65±0.14**	**0.65±0.14**	**8.585* (<0.001)**	**7.685* (<0.001)**	**0.201 (0.84)**
(62)	Chemical hazards	0.30±0.28	0.49±0.30	0.57±0.30	4.617* (<0.001)	5.803* (<0.001)	2.249* (0.03)
	Hazard communication	0.54±0.29	0.78±0.24	0.67±0.24	5.709* (<0.001)	2.794* (0.01)	-3.303* (0.002)
	Ionizing radiation	0.54±0.26	0.73±0.23	0.75±0.22	4.589* (<0.001)	5.360* (<0.001)	0.782 (0.44)
	Respiratory protection	0.62±0.27	0.67±0.26	0.72±0.24	1.051 (0.30)	2.746* (0.01)	1.454 (0.15)
	Personal protective equipment	0.71±0.33	0.86±0.22	0.88±0.23	3.028* (0.004)	3.689* (<0.001)	0.567 (0.57)
	Noise	0.45±0.29	0.50±0.29	0.54±0.28	0.956 (0.34)	2.052* (0.04)	1.000 (0.32)
	Nonionizing radiation	0.36±0.27	0.59±0.28	0.61±0.34	4.300* (<0.001)	4.882* (<0.001)	0.582 (0.56)
	Biological hazards	0.48±0.33	0.53±0.29	0.58±0.31	1.196 (0.24)	2.392* (0.02)	1.384 (0.17)
Control	**Total**	**0.51±0.10**	**0.54±0.10**	**0.52±0.14**	**1.989 (0.05)**	**0.805 (0.42)**	**-0.899 (0.37)**
	Chemical hazards	0.26±0.25	0.31±0.24	0.36±0.25	1.236 (0.22)	2.605* (0.01)	1.458 (0.15)

(62)	Hazard communication	0.61±0.28	0.54±0.25	0.59±0.26	-1.584 (0.12)	-0.354 (0.73)	1.456 (0.15)
	Ionizing radiation	0.60±0.24	0.62±0.21	0.59±0.26	0.683 (0.50)	-0.314 (0.76)	-1.095 (0.28)
	Respiratory protection	0.65±0.30	0.71±0.27	0.69±0.27	1.387 (0.17)	0.882 (0.38)	-0.531 (0.60)
	Personal protective equipment	0.72±0.30	0.67±0.28	0.77±0.32	-1.229 (0.22)	0.903 (0.37)	2.049 (0.05)
	Noise	0.48±0.32	0.47±0.27	0.48±0.30	-0.119 (0.91)	0.112 (0.91)	0.222 (0.83)
	Nonionizing radiation	0.40±0.24	0.39±0.25	0.33±0.28	-0.190 (0.85)	-1.436 (0.16)	-1.199 (0.24)
	Biological hazards	0.45±0.29	0.52±0.28	0.47±0.27	1.758 (0.08)	0.480 (0.63)	-1.146 (0.26)

* p–Value < 0.05

365 **TABLE 4.** OHS attitude, self-efficacy and behavioral intention improvements of the intervention and control groups

Group (n)	OHS Aspect	Mean Score (mean±SD)			Pair-*t* (*p*-Value)		
		Pretest	Posttest	Follow-up test	Pre *vs.* Post	Pre *vs.* Follow-up	Post *vs.* Follow-up
Intervention (62)	Attitude	2.83±0.31	3.00±0.41	3.02±0.40	3.198*(0.002)	3.568*(0.001)	0.322 (0.75)
	General safety perception	4.09±0.46	4.17±0.49	4.11±0.49	1.377 (0.17)	0.318 (0.75)	-1.221 (0.23)
	Specific safety perception	3.99±0.39	4.05±0.42	4.05±0.42	0.904 (0.37)	1.038 (0.30)	0.104 (0.92)
	General safety practice	3.90±0.42	4.08±0.51	4.10±0.52	2.757* (0.01)	2.913* (0.01)	0.350 (0.73)
	Specific safety practice	3.36±0.36	3.71±0.54	3.80±0.50	5.238* (<0.001)	7.509* (<0.001)	1.653 (0.10)
	Self-efficacy	3.73±0.69	3.73±0.69	3.81±0.63	NA	0.843 (0.40)	0.843 (0.40)
	OHS behavioral intention	3.01±0.40	3.06±0.51	3.21±0.46	0.946 (0.35)	2.987* (0.004)	2.038* (0.04)
Control (62)	Attitude	2.90±0.42	3.01±0.34	2.94±0.38	2.204*(0.03)	0.761 (0.45)	-1.622 (0.11)
	General safety	4.17±0.53	4.23±0.44	4.14±0.43	0.897 (0.37)	-0.609 (0.55)	-1.520 (0.13)

perception						
Specific safety perception	4.02±0.45	4.10±0.37	4.00±0.42	1.588 (0.12)	-0.424 (0.67)	-1.840 (0.71)
General safety practice	3.97±0.55	4.19±0.53	4.06±0.51	2.786* (0.007)	1.154 (0.25)	-1.746 (0.09)
Specific safety practice	3.45±0.45	3.52±0.42	3.54±0.46	1.542 (0.13)	1.672 (0.10)	0.380 (0.71)
Self-efficacy	3.76±0.62	3.76±0.62	3.68±0.71	NA	-1.031 (0.31)	-1.031 (0.31)
Behavioral intention	3.03±0.35	3.05±0.44	3.06±0.45	0.367(0.72)	0.434 (0.66)	0.154 (0.88)

NA: t cannot be calculated because the standard error of the difference is 0
* *P*–value < 0.05

TABLE 5. Adjusted association of respondents' OHS knowledge, attitude and behavioral intention in relation to two groups and three tests

	Knowledge		General safety practice		Specific safety practice		Behavioral intention	
Factors	β (95%CI)	*p*–Value	β (95%CI)	*p*–Value	β (95%CI)	*p*–Value	β (95%CI)	*p*–Value
Test								
Pretest (reference)	0		0		0		0	
Posttest	0.092* (0.070–0.114)	<0.001	0.206* (0.127–0.286)	<0.001	0.207* (0.131–0.283)	<0.001	0.060 (-0.009–0.129)	0.09
Follow-up test	0.087* (0.062–0.113)	<0.001	0.173* (0.088–0.258)	<0.001	0.253* (0.177–0.329)	<0.001	0.118* (0.035–0.201)	0.01
Group								
Control (reference)	0		0		0		0	
Intervention	0.066* (0.040–0.093)	<0.0001	-0.018 (-0.143–0.108)	0.78	0.134* (0.007–0.261)	0.04	0.079 (-0.025–0.184)	0.14

* *p*–Value < 0.05

370 + GEE regression models analyses were used with adjustment for gender, academic groups, years of schooling, part–time job experience, OHS training from part–time job employers, and family members work as OHS profession.

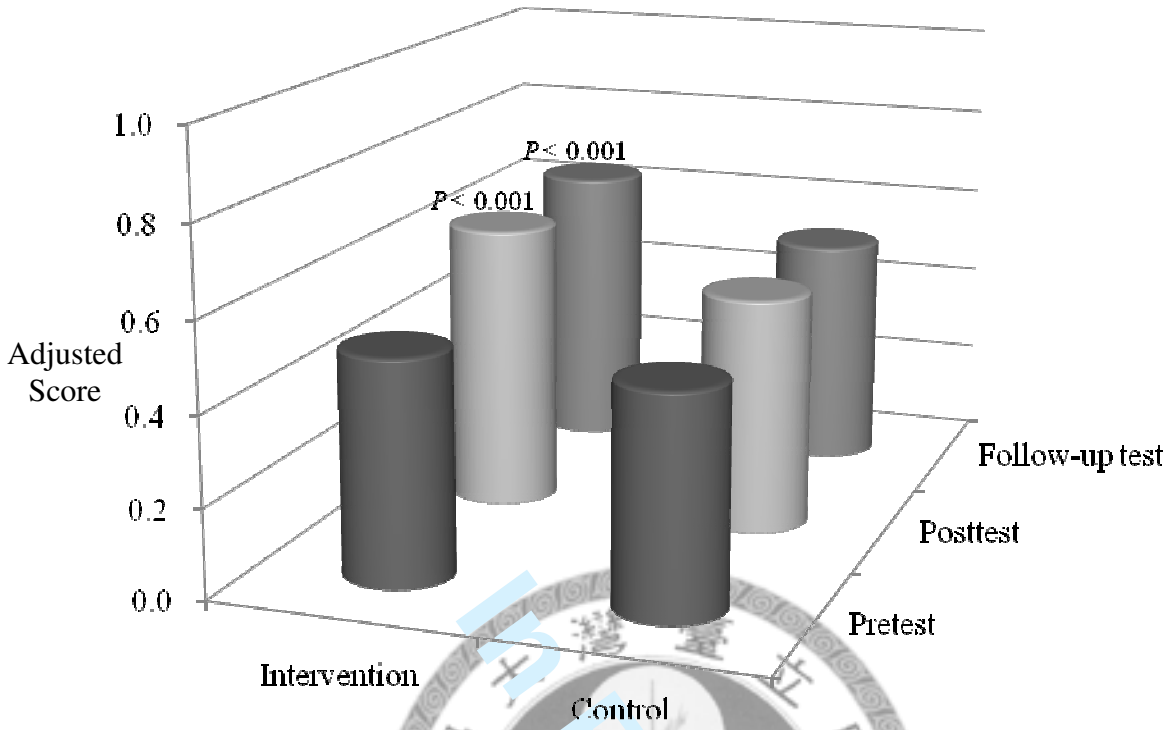

FIGURE 1. Adjusted scores of knowledge by intervention and three tests according to the results of GEE regression models.

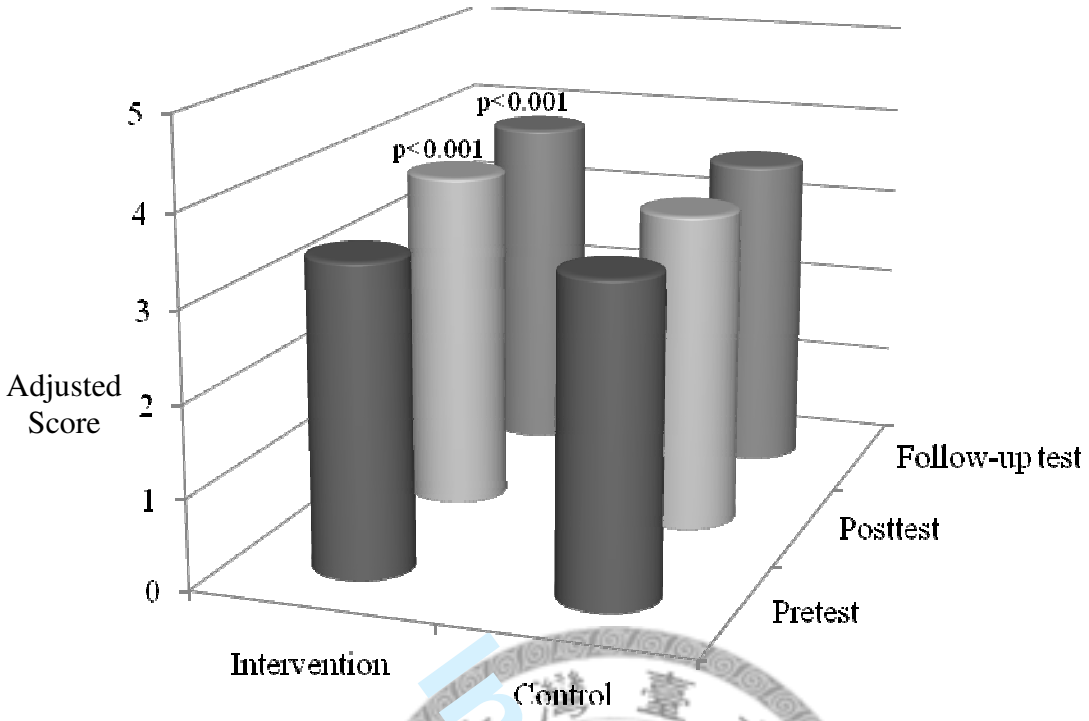

FIGURE 2. Adjusted scores of specific safety practice by intervention and three tests according to the results of GEE regression models.

380

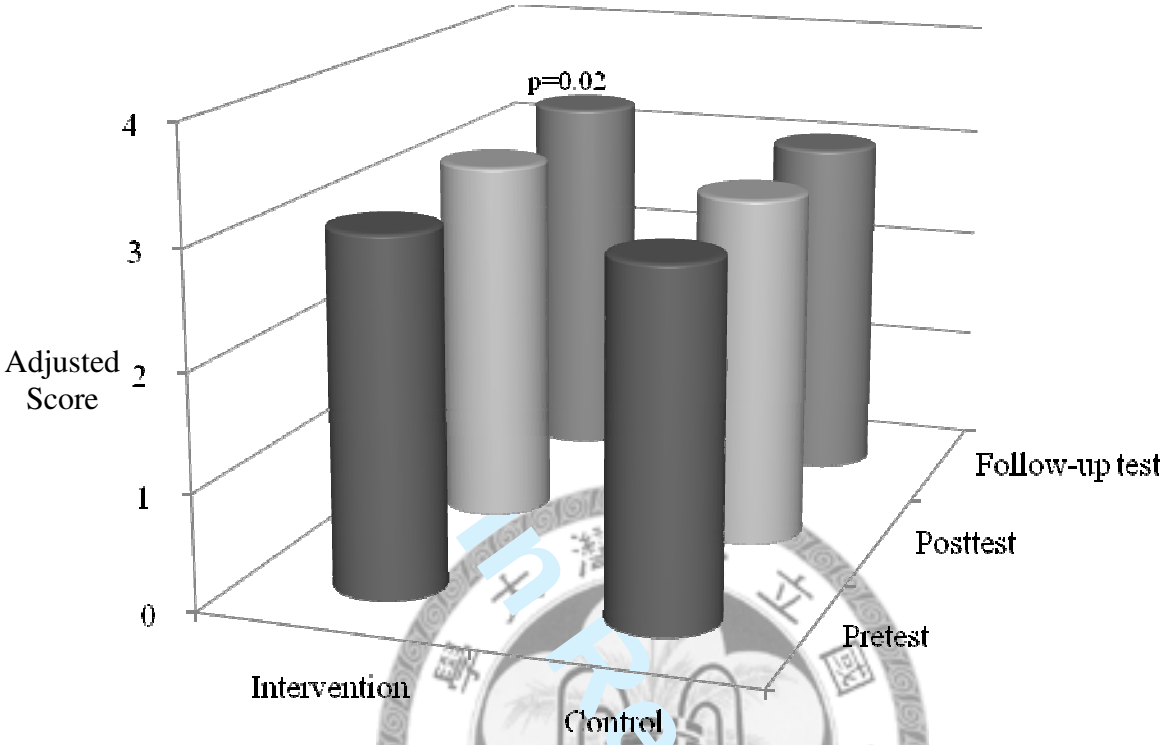

FIGURE 3. Adjusted scores of behavioral intention by intervention and three tests according to the results of GEE regression models.