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主編的話

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本期《教育研究與發展期刊》所刊出的學術論文，展現出多元的學術內容，每篇稿件經過嚴謹的匿名審查，作者反覆的費心修改，再經由本刊編輯委員會全體委員複審及討論後，決議刊載以下三篇論文。三篇論文在領域上，分屬「師資培育與教師專業發展」及「課程與教學」等領域，探討以概念構圖為核心之國小雙語自然教材教法課程對雙語師資生之影響，STEAM 融入戶外冒險之跨領域創意教學，以及臺灣華語教學師資生創造力之分析等豐富的教育議題；在研究取向上，分別採取教學實驗設計、混合式研究法、調查研究設計等多元的研究方法；在語言上，二篇為中文稿，一篇為英文稿。本期論文研究主題多元，每篇皆為值得一讀的佳文，希望藉由研究成果提供教育政策更多的省思與體悟。茲簡述各篇亮點如後。

第一篇「以概念構圖為核心之國小雙語自然教材教法課程：雙語師資生於課程中的成長與反饋」，本研究透過教學實驗設計，以概念構圖融入雙語自然教材教法，探討參與雙語自然次專長師資培育課程的師資生在知識結構與教學目標設定之改變，以及師資生參與課程後的成長與反饋。本篇結果顯示 iCM-BS 課程的概念構圖知識結構視覺表徵，可協助師資生建立科學概念的邏輯關聯，課程亦可協助不同背景師資生統整並設定雙語自然之自然與語言教學目標。本文深入剖析在新課綱實施與雙語政策推動後，將概念構圖融入所開設的國小雙語自然次專長師資培育課程之可行性與對師資生之影響，在當前重視雙語融入次專長領域的政策下，對未來師資培育機構在規劃相關課程，或是有志從事雙語教學之師資生，皆極具啟發性，應能為臺灣雙語教育政策提供相對應的啟示。

第二篇「STEAM 融入戶外冒險之跨領域創意教學研究」，透過混合研究法，在一門「潛水、海洋文化與遊憩探索」的跨領域課程中，採用 STEAM 融入戶外冒險活動的教學並探討此種跨領域創意教學之成效。本文藉由量化與質性資料的蒐集，發現戶外冒險活動融入 STEAM 跨領域知識是有效的教學策略，但由於研究樣本少，量化分析結果之推論性有所侷限。事實上不論是十九項議題中的戶外教育，抑或是跨領域教育，都是當前熱門議題，本文嘗試結合兩種議題設計出具有創意的

教學設計，不但有學術上的創新性，也有教學實務上的應用性，若能透過本文拋磚引玉，吸引更多研究者在這些熱門議題上進行創新的教學設計，相信能引發更多教育上結合不同議題的新創見！

第三篇「An Analytical Study on Establishing Norms for Creativity among Pre-service TCSOL Teacher Education Students in Taiwan」為一篇英文稿，旨在為臺灣華語教學師資生建立創造力常模，並分析其創造力之異同。研究結果除了建立臺灣華語教學師資生之創造力常模外，也發現不同背景之華語教學師資生在部分創造力上有顯著差異。本篇最令人驚艷之處，在於根據研究發現提出「創意花模式」的教學架構，作為臺灣華語教學系所和學分學程課之設計基礎，並為華語教學師資生提供相對應的教學策略，此種教學架構在國內較為少見，有其創新性，因此對未來有意深入探究創造力之議題極具參考價值！

本期論文敬邀教育領域的學者專家共同閱覽，感謝本期所有作者對教育研究的投入，分享兼具學理與實務價值的佳文，期盼這些研究成果能引發更前瞻的發想，對教育政策發揮實質的影響力。也再次感謝各篇審查委員、本刊編輯委員會委員的審查意見與修改建議，以及出版中心工作同仁的努力，讓本期得以順利出刊。感謝教育領域的學者專家一直以來對《教育研究與發展期刊》的支持與關注，歡迎學界先進惠賜稿件，亦歡迎學者專家針對教育新興議題撰稿至本刊的「研究趨勢評論」專欄共襄盛舉，共同為促進臺灣教育研究而努力。

主編 龔心怡 謹識

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以概念構圖為核心之國小雙語自然教材教法課程：雙語師資生於課程中的成長與反饋

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摘　要

本研究因應新課綱實施與雙語政策推動開設第一屆國小雙語自然次專長師資培育課程，將概念構圖融入雙語自然教材教法（Integrating concept mapping into bilingual science material and teaching course, iCM-BS）以探討 iCM-BS 課程：（一）使雙語師資生的知識結構與教學目標設定產生什麼改變？（二）如何協助不同背景師資生設計雙語自然教學？（三）不同背景師資生的學習需求與意見反饋為何？本研究以全班 33 位師資生為對象，以 Novak 與 Gowin 的評鑑方式對 8 組師資生所繪製概念圖的自然科學知識結構評分以回答第一個研究問題，後續二個問題則以蒐集三位不同背景同學的質性資料、授課教師教學反思及研究團隊會議紀錄經由團隊不同研究者分析與反覆比較形成研究主張。研究結果顯示 iCM-BS 課程中概念構圖知識結構的視覺表徵：（一）可協助師資生建立科學概念的邏輯關聯以掌握教材內容、檢核知識結構以適應教學活動；（二）可協助不同背景師資生統整並設定雙語自然教案中的自然與語言教學目標；（三）不同背景師資生雖然學習需求不同，但同儕間分享教材理解與教學經驗卻可增進雙語自然教學活動構思與規劃成效。最終則基於教學與研究觀察於文末提出相關建議。

關鍵詞：師資培育、概念構圖、雙語自然教學

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An Integration of Concept Mapping into a Course of Bilingual Science Material and Teaching: The Growth and Feedback of Pre-service Teachers

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Abstract

In response to the new Curriculum Guidelines and the 2030 Bilingual Policy, this study integrates concept mapping into a course of bilingual science (iCM-BS) material and teaching for pre-service teachers and tries to figure out: (1) What changes does the course have on pre-service teachers' scientific knowledge structure and the setting of their teaching goals? (2) How does the course assist pre-service teachers in lesson planning? (3) What are the learning needs and feedback from pre-service teachers in different disciplines? This case study focused on 33 pre-service teachers participating in this course, which belongs to a sub-specialty program for elementary bilingual science teachers. To investigate the first question, their concept maps were used to assess their scientific knowledge structure using the scoring system of Novak & Gowin. Then, the non-numerical data of 3 chosen pre-service teachers with different disciplines were collected and analyzed to answer the other two questions. The results show that the iCM-BS course: (1) can graphically organize the logical connections between scientific concepts and then help pre-service teachers grasp the teaching context, (2) can help pre-service teachers with different disciplines in lesson planning of bilingual science, despite the variety of their learning needs, and (3) provides pre-service teachers a way to check their scientific knowledge structure to fit with the cognitive levels of learners as a guide that can integrate their teaching objectives of science and language. At the end of this article, we reflect on this course of iCM-BS and make suggestions.

Keywords: teacher education, concept mapping, bilingual science teaching

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壹、緒論

因應《十二年國民基本教育課程綱要》（以下簡稱新課綱。教育部，2014）的實施，教師須將素養導向的教學理念貫徹於各學科教學活動中（符碧真，2018）。而《自然領域課程綱要》（以下簡稱自然領綱。教育部，2018a）則揭示國小自然領域教學宜源於生活觀察與需要，期能學以致用並成為終身學習者。而近來政府提出〈2030 雙語政策〉（國家發展委員會、教育部，2020）並積極推行的雙語教育若欲與自然領域課程相結合，教師除了必須掌握學科知識外，尚須具備整合學科與語言領域教學設計之能力。羅文杏（2021）的研究發現教師在學科雙語教學所面臨的挑戰包含：不熟悉學科內容、無法以英語教授學科、知識性學科與第二語言整合學習（Content-Language Integrated Learning, CLIL）雙語課程的不確定性與缺乏雙語教材等。然而學科雙語教學現場目前迫切需要符合新課綱素養導向的學科雙語教材與教案（陳錦芬，2023），但現階段仍只有各學科領域的中文版本教科書可供選擇。因此，如何以跨越語言與學科領域的協作觀點（黃彥文，2021）統整學科與語言領域教學目標實為當務之急。

據教育部（2022）制訂的《師資職前教育階段暨師資職前教育課程基準》，「教材教法」與「教學實習」是國小師資學科教學知識養成最重要的兩門課程（林永豐，2022），但如何將語言與學科教學目標妥善地結合以適合臺灣本地的教學現場需求，目前各界尚未能凝聚共識。由於概念構圖能使學生在英文閱讀中掌握文章重要與次要概念、整理文章結構並幫助記憶，被證實可有效提升英文閱讀（劉沛琳，2008），也是科學教育所重視的學習策略與評量工具（江淑卿，2001）。因此周金城（2021）提出可藉由概念構圖法統整自然與英語領域，以整合雙語自然教學活動並協助釐清科學知識架構。故本研究嘗試以概念構圖法連結並統整自然與英語雙領域的學習內容，引導師資生設計雙語自然教案並可據此進行雙語自然之微型試教。然而林靜雯等人（2022）的初步研究結果發現，iCM-BS 課程能夠顯著提升師資生的雙語自然教學、掌握自然領域內容與語言兩項目的自我效能，顯示其統整學科內容與語言的潛力。故本研究擬探討 iCM-BS 課程：（一）使雙語師資生的知識結構與教學目標設定產生什麼改變？（二）如何協助不同背景師資生設計雙語自然教學？（三）不同背景師資生的學習需求與意見反饋為何？

貳、文獻探討

一、課綱為本的雙語教學設計

新課綱（教育部，2014）素養導向的精神在內奠基於「以學習者為中心」（陳麗華，2018），並以整合、脈絡、歷程與實踐等形貌顯之於外（范信賢，2019），因此具備了多元的生成觀點而非僵化的過程實踐，歐用生（2018）據此提出了：重視學習歷程、適當轉化以應用於生活情境、包容多元形式與批判解構再建構等各項建議。可見得「包容多元形式與語言」的雙語教學，在不犧牲學科內容主體與探究深度的前提之下，能與素養導向的教學理念適當結合而沒有理念矛盾。但教師須摒棄教學者為中心的成見、跳脫教科書框架的限制，以學習者的需求出發、以提升學習成果為目標來進行教學設計（Davidovitch, 2013）。自然領綱（教育部，2018a）係根據不同學習階段學習者身心發展特性，縱向規劃不同學習階段學生的「科學認知、探究能力、科學態度與本質」等三類「學習表現」，以及「自然界組成與特性、自然界的現象規律及作用、自然界的永續發展」等三個主要課題的「學習內容」，作為課程發展與教學設計的依據，新課綱聚焦於學生需求與學習成果，奠基於相關課程標準（standards-based，以下簡稱標準本位），並顛覆傳統教科書為主的逆向設計概念（McTighe & Thomas, 2003），已成為我國課程改革的發展趨勢（呂秀蓮，2019）。課程的發展若無領綱指引，教師教學設計時可能會因教學目標不明而將雙語自然課程誤植成為英語課。但若能從標準本位的設計模式出發，以自然領綱與《英語文領域課程綱要》（以下簡稱英語領綱。教育部，2018b）為指引並輔以概念構圖法協助釐清該單元科學知識架構，則可避免教學重點偏移，且有助於統整自然與英語領域的學習內容（林靜雯、鄭宏文，2024），讓雙語教師有餘裕挑選並運用學生熟悉的生活題材，協助學生有意義地學習，成為終身學習者以從容面對未來挑戰。

二、自然領域雙語教學的現況與困境

（一）雙語教學的多元模式

從加入英語以進行英語教學的模式來說，可以將雙語教學區分為完全沉浸（full immersion）、結構沉浸（structured immersion）、過渡性雙語（transitional bilingual programs）及同時掌握母語及英語（two-way bilingual programs）等四種模式（盧

雯月，2021），其中因主張避免翻譯重複而降低學習效率（Lewis et al., 2012），故排除第一語言的完全沉浸式英語環境實屬於分離式雙語觀（張學謙，2016），而由於其他三種模式在課堂中使用了不同語言（García, 2009），則必將發生不同語言的接觸與語碼轉換（code switching）。彈性式雙語觀（張學謙，2016）建議目標語教學應善用第一語言與語碼轉換以搭建語言間橋梁，García（2009）認為跨語言實踐（translanguaging）是流動不拘的語言實踐，鄒文莉（2021）則認為必須預先規劃練習方能夠基於明確目標以結合不同語言媒介完成跨語言溝通。雖然學習第二語言的過程中可以同步使用兩種語言（Cummins, 1992），但添加式（additive bilingualism）與過渡式兩類的雙語教學環境（Freeman et al., 2005）對於第一語言的態度並不相同：前者兼顧二者發展（范莎惠，2020），但後者則將第一語言視為過渡性工具並逐步減少其使用頻率（張學謙，2016）。至於其間中英文語言比例問題，陳純音與林慶隆（2021）建議依據學生的學習回饋，動態調適以協助其完成學習任務。

由於雙語教學的執行模式十分多元，常因眾說紛紜而莫衷一是，然本文意在探討並發展國小自然領域雙語教學的師資培育課程，故教學目標側重於自然領域的學科內容。然根據新課綱的規劃，國小英語教學始於第二學習階段，惟各縣市不同國小的實施情況並不一致，為兼顧「拔尖」與「扶弱」的雙重需求，在不犧牲自然領域的學科內容主體與探究深度的前提下，教學語言工具的選擇須符合一般學童能力，故本研究採取第一與第二語言同時使用的添加式雙語教學環境，而語言比例則以符合國小學童學習需求為原則，作為本研究雙語自然師資培育課程的教學設定。

（二）自然領域雙語教學的困境

黃怡萍與鄒文莉（2022）將雙語教育定義為「使用兩種語言進行學科領域教學」。但整合二者的模式卻可依據教學目標區分為：視第二語言為目標但學科內容為媒介（Content Based Instruction）的 CBI、將二者整合學習的 CLIL（Coyle et al., 2010），以及視學科內容為目標但第二語言為媒介（English as a medium of instruction）的 EMI（鍾智林、羅美蘭，2021）等三類。由於本研究欲發展以學科內容為主體的國小自然領域雙語教學之師資培育課程，且國小學童的英語溝通與交流能力因初學尚在啟蒙發展而無法直接將英語作為成熟的學科教學語言工具，故本研究雙語國民小學自然科學領域教材教法課程排除了 CBI 與 EMI 模式，最後採取了 CLIL 架構。Coyle（1999）在 CLIL 架構下整合學科內容、語言溝通、認知思考與文化交流四個面向並發展 4C’s 概念，高實玫與鄒文莉（2021）則以此為基礎提

出 4C 2+ 的「全球在地化臺灣雙語教育模式」以強調：跨語言溝通策略與任務實作鷹架。上述理論架構下的語言學習（鄒文莉等人，2018）可細分為：language of/for/through learning 等三類（以下簡稱 L of/for/through L），Coyle（2007）則以 the what 來詮釋 L of L，簡雅臻（2021）稱之為「學科重要概念語言」、以 how to 來詮釋 L for L，田耐青（2021）稱之為「學習所需的語言」、最後則以 the why 來詮釋 L through L，也就是學習者基於已學習的內容，經由互動逐步自我建構發展的自發語言。雙語自然教學須兼顧自然領域學科內容與英語學習目標，但是羅文杏（2021）的研究卻顯示在進行 CLIL 教學時，雙語教師面臨了「英語教師學科知能不足、學科教師英語能力不夠」的挑戰。具備教學經驗的在職教師尚且如此，對於初學的新手師資生來說，認知負荷與焦慮感只會更加嚴重。為避免學科雙語教學因而偏離預定目標以適應國內學科雙語學習的需求，顯然除了跨領域專長共同備課之外，國小雙語自然師資培育課程尚須發展一套便於新手師資生入門的學科雙語教學發展策略。

三、概念圖

本研究所稱的概念圖，其特徵包含有：概念、連結語、橫向連結、階層結構、命題陳述等（Novak & Gowin, 1984），係指由節點所代表的科學概念、節點間連結後所形成的命題陳述，並於最底階層舉出事例佐證。概念圖係以視覺化圖型組織方式呈現人類記憶系統中的認知基模結構，復以命題陳述呈現出不同科學概念間的關聯，而不同概念與命題陳述形成不同群集，並可透過橫向連結統整其邏輯關係並賦予群集間的嶄新意義（Ausubel, 1977; Collins & Quillian, 1969）。

新手師資生由於缺乏教學實務經驗，對教材內容的理解較為零散與片段，但概念構圖可協助師資生將零散的知識有效彙整為更有用的資訊，並可以其知識架構代替大腦進行較為繁複的類化工作。作為圖形化組織，概念構圖法亦可作為一種理解策略，或在教學前、中、後各自承擔不同的任務角色，有效提升學習者的理解與統整能力（Chang et al., 2002）。以自然領域課程的教學應用為例，概念構圖法能夠將科學命題陳述以圖形表徵的方式，在國小自然科教學中提供專家的知識結構，特別有助於對相關科學概念的理解（江淑卿，2001）。然若作為一種後設認知策略，概念構圖除了可協助使用者掌握、回顧、統整內容，並提升其英文閱讀能力之外，亦可觸發其覺察並監控自己的學習歷程，以促進有意義的學習或進行自我評鑑並增強其英文閱讀信心（劉沛琳，2008）。

由於概念構圖法同時被應用於英文閱讀與科學教育中，故本研究擬以自然領綱及英語領綱（教育部，2018a，2018b）為標準本位，續以單元概念圖的知識架構為工具以聯繫並統整自然學科與英語文領域的學習目標，將之應用於國民小學自然科學領域雙語教材教法課程，以國小三年級新課綱自然領域某出版社教科書為教材，繪製單元概念圖以統整自然領域的學習內容與知識結構，協助師資生掌握教案中的「學科重要概念語言」以設定英語目標字詞及目標句型，統整自然與英語雙領域的學習內容、引導師資生連結不同領域的學習目標以設計雙語自然教案、並據此進行雙語自然之微型試教並提升其學習成效，使研究結論能夠作為雙語自然師資培育課程之後續發展基礎。

參、研究方法

一、研究設計與規劃

教育部於 109 年 6 月委託師資培育大學辦理「現職教師雙語教學增能學分班實踐計畫」，開設包含國中小學在職雙語教學增能學分班及說明會，說明會分為導師班及講師班，由國立成功大學辦理。本研究第一作者與第二作者皆參與並完成說明會講師班之培訓課程，在接續完成該計畫所開設在職增能學分班講師任務後，始共同於北部某大學開設第一屆雙語自然次專長的雙語國民小學自然科學領域教材教法課程以作為本研究之場域。但因為是雙語自然次專長模組的首屆開課，故學生之前皆未選修過其他雙語課程，且因本班另有其他 7 位師資生不具備雙語次專長身分，故授課教師將總數 33 名師資生併班進行雙語授課。另外因全班只有 4 位外系學生（分屬於藝術、中文、教育與英文）不屬於原開課系所，故授課教師以異質分組為原則，輔導其分別加入原開課系所學生依意願所分 8 組中之不同組別。各組再抽籤分配三年級新課綱某出版社自然領域教科書 8 個單元。因各組師資生於本課程表 1 所列舉各階段教學活動之中經教學者引導進行反思、覺察與討論後，其單元概念圖共歷經 4 次修正。然同一組別單元概念圖的得分變化即可呈現出該組師資生在教學歷程中的知識結構的改變，亦可作為後續師資生教學設計變化等質性資料成因推論之佐證。各組復據其知識結構規劃該單元共 12 節課的教學活動簡案，組員再各自挑選 1 節 40 分鐘課程以設計教學活動詳案並進行個人 10 分鐘濃縮版之微型試教，並規定 26 位雙語次專長師資生必須採雙語模式，但 7 位非雙語師資生則不在

此限。各組復據其知識結構規劃該單元共 12 節課的教學活動簡案，組員再各自挑選 1 節 40 分鐘課程以設計教學活動詳案並進行個人 10 分鐘濃縮版之微型試教，並規定 26 位雙語次專長師資生必須採雙語模式，但 7 位非雙語師資生則不在此限。

本研究欲探討 iCM-BS 課程：（一）使雙語師資生的知識結構與教學目標設定產生什麼改變？（二）如何協助不同背景師資生設計雙語自然教學？（三）不同背景師資生的學習需求與意見反饋為何？研究採單一個案嵌入式設計（single case embedded design）（Yin, 2014）蒐集師資生各項資料進行分析。第一個研究問題針對 8 組師資生所繪製 3 次中文概念圖與 1 次英文概念圖（合計 32 幅）的自然科學知識結構，依據 Novak 與 Gowin（1984）對概念圖的評鑑方式計分，並以無母數 Friedman 檢定全班概念圖知識結構改變的整體狀況，以作為後續推論及分析比對質性資料之依據。而後續二個研究問題則依據師資生就讀系所（詳見表 1）挑選不同背景雙語師資生作為研究對象，包括：自然相關系所（S1-3）、英語相關系所（S2-3）與教育相關系所（S1-1）的師資生共 3 位，以蒐集個案師資生雙語自然教案中的自然與英語雙領域的教學目標、師資生個人反思、與授課教師教學反思及研究團隊的會議紀錄等多元資料，將上述研究問題透過研究團隊不同研究者針對多元資料反覆比較形成主張。

表 1

雙語國民小學自然科學領域教材教法課程的教學活動規劃、資料蒐集與彙整

課程主題		活動內容	資料蒐集
分類	主題名稱		資料名稱
奠基課程一	課程簡介	1. 學期課程規劃 2. 觀摩雙語自然教學得獎演示影片 3. 分組、分配單元	分組名單與單元分配表
	教案撰寫與概念圖	1. 雙語教案的架構 2. 教科書第六章 3. 概念構圖	單元概念圖 v1 中文
	學習目標的設定	1. 認識自然領綱 2. 認識學習表現指標 3. 認識學習內容指標 4. 練習綑綁學習目標	單元學習目標 v1 中文
	自然領綱與概念構圖教學法	1. 教學法概要與介紹 2. 概念構圖教學法	單元概念圖 v2 中文
	CLIL 教學法	1. CLIL 教學法 2. 4C 與 2+ 的意涵 3. Language of / for Learning	學習目標 v2 中文、目標字詞與句型 v1

（續）

表 1

雙語國民小學自然科學領域教材教法課程的教學活動規劃、資料蒐集與彙整（續）

課程主題		活動內容	資料蒐集
分類	主題名稱		資料名稱
奠基課程二	學習評量與科學探究輔具	1. 教科書第五、八章 2. 素養導向雙語自然學習評量的設計 3. 科學探究輔具應用	教案的評量尺規、單元概念圖 v3 中文
	概念圖與教案初稿討論	1. 邀請 B 校小學專家 2 人參與討論 2. 自然領域討論內容：小組概念圖、學習目標與教學活動設計、評量尺規 3. 英語領域討論內容：目標字詞、目標句型	學習目標 v3 中文、單元概念圖 v4 英文、目標字詞與句型 v2
	教學環境規劃與雙語自然教學資源	1. 教學環境規劃與活動管理 2. 自然領域與雙語教學的教學資源	小組單元的雙語自然共同教案最終統整版
教學觀摩	學長姐集中實習	於 A 校觀摩學長姐集中實習之教學：觀課與議課	觀課記錄表與議課單
	雙語教師實際教學	B 校雙語自然課之說課、觀課與議課	觀課記錄表與議課單
課後討論	課後討論	1. 教學者參與師資生分組討論 2. 不同組師資生的分組討論	群組討論對話記錄、研究團隊會議記錄
微型試教	教學演示	1. 雙語自然教學微型試教：每人 10 分鐘 2. 大學教授 3 人與師資生共同議課	組員個人依據教案進行 10 分鐘微型教學
	總結與反思	1. 師資生的自我反思 2. 師資生的課程回饋	師資生的教學反思回饋

二、教學設計

研究者先與開課系所內 5 位擬開設雙語自然次專長學程之教授們經過一學年間的密集會議凝聚共識，設定以概念構圖協助師資生釐清科學知識結構並激發語言覺察之核心理念（林靜雯等人，2022）。本研究雙語國民小學自然科學領域教材教法課程的教學目標設定為：

（一）能理解新課綱與自然科學領域的學習內容。

（二）可考量學生特徵以設計國小雙語自然教案。

（三）能透過微型試教進行反思修正教案與教學。

本課程 2 學分，每週 2 節課共 18 週，以該班級師資生下一個學年即將進行三週集中實習之國小（A 校）的學童為教案設定的教學對象，並以《國小自然科學教材教法》（黃鴻博主編，2020）為教科書，課程中以 Novak 與 Gowin（1984）所發展的概念圖評分架構輔助師資生繪製單元概念圖，用以協助師資生組織、理解國小自然科學的概念架構，復以自然領綱學習內容與學習表現指標為本位，引導師資

生訂定素養導向之自然領域教學目標。課程期間除了安排至臺北市某雙語前導國小（B 校）觀摩該校現職雙語教師的雙語自然教學之外，課程期間還另安排參訪 A 校觀摩學長姐集中實習之非雙語教學演示，並邀請 A 校雙語自然教學團隊教師與本班師資生針對其所繪製單元概念圖的知識架構進行討論、分享其對於該校學童於自然領域與英語程度的瞭解。最後再以英文領綱中的學習內容與學習表現指標為本位，以單元概念圖的知識結構提供師資生統整教案中自然及英語文領域的學習內容，作為設定目標字詞、目標句型與課室用語之參考依據。最後師資生依據教案進行教學演示並透過觀課、三位大學教授、一位國小雙語自然教師與一位國小英語教師、以及同儕在議課時所提供的反饋，對教學計畫進行反思與檢討。茲將教學活動規劃、學習內容與資料蒐集歸納彙整於表 2。

表 2

iCM-BS 課程中師資生背景資料與研究對象挑選之依據

師資生基本資料					研究對象的挑選				
次專長	就讀系所領域分類		國小代課年資	人數	挑選：該條件是否具備？				依據背景差異挑選
	自然	英語			雙語次專長	自然領域	英語領域	教學年資	
非雙語	自然	非英語	無	7	×	○	×	×	不挑選
雙語	自然	非英語	無	22	○	○	×	×	S1-3
雙語	非自然	非英語	無	2	○	×	×	×	不挑選
雙語	非自然	非英語	6 年	1	○	×	×	○	S1-1 *
雙語	非自然	英語	無	1	○	×	○	×	S2-3

* 本研究依據選課名單就讀系所資料協助師資生進行異質分組，挑選 S1-1 為個案研究對象係因為該生表示就讀開課學校教育相關系所之前已具備 6 年偏鄉自然代課教師經驗，然事後深入訪談始得知該生代課經歷前已具備他校理學院學士與碩士學位。

三、研究工具與資料分析

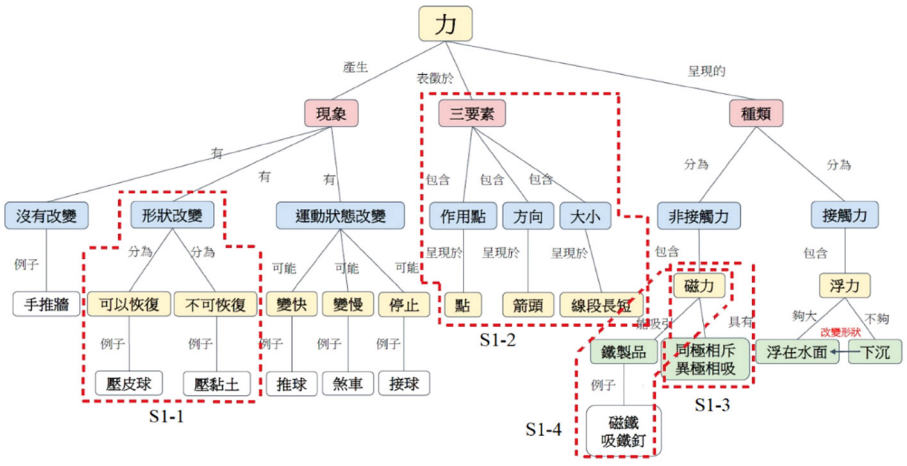
本研究以師資生所繪製的單元概念圖與撰寫的雙語自然教案為研究工具，其格式以開課學校全英語教學研究中心所制定的〈國民小學素養導向數學、自然科學雙語教學教案〉為基礎。師資生針對其單元內容進行小組討論，在教案的「概念分析」一節中共同繪製單元概念圖以學習並組織該單元的知識結構，作為後續統整英語文領域教學目標之依據，復據其知識架構以規劃該單元共 12 節課的教學活動簡案，再將合適的自然領綱學習表現與學習內容指標綁定成為該單元各節課的學習目

標，隨後組員再各自挑選 1 節課以設計 40 分鐘的詳案，再據此並依其教學順序分別進行 10 分鐘濃縮版的微型試教且全程錄影（不可剪接）。

由於各組師資生於本課程各階段的教學活動中經教學者引導進行反思、覺察與討論後，其單元概念圖共歷經 4 次修正（以下簡稱 v1 ～ v4）。茲以第 1 組的單元概念圖 v1（詳見圖 1）為例說明概念圖的評分規則（相關細目請詳見表 3）：（一）正確的命題陳述（經由連結語連結不同概念而形成，第 1 組概念圖 v1 命題陳述詳見表 4）給予 1 ～ 2 分；（二）每個有效的階層（概念由上位分化成多個下位概念時始稱之）給予 5 分；（三）有效橫向連結且能統整群集間概念者給予 10 分，若僅存在特例連結者僅給 2 分；（四）有效事例給予 1 分（但不給予階層分數）。研究團隊先經由焦點會議達成評分共識，三位評分員再據此對其中兩組單元概念圖進行評分，並將「評分者信度」定義為「評分者達成一致性的百分比」。評分過程中討論較多之處為：命題是否有效的判定與命題是否服膺自然領綱指標這兩個面向，評分共識形成後的評分者信度則分別是 100%與 98%，續針對不一致處再經討論以取得共識，再分工完成全班其餘各組概念圖的評分工作。由於修課人數眾多，觀課任務須於課餘時段完成，議課則以彙整討論的形式為之。最後由研究者蒐集授課教師、小學英語與雙語教師和同儕互評之微型教學回饋單、師資生的自我教學反思、授課教師的教學反思及研究會議紀錄等多元資料進行分析。其課程活動規劃與相關資料的蒐集請詳見表 2 所示。

圖 1

第 1 組單元概念圖 v1



註：虛線框表示知識結構中個別師資生所負責的學習內容主題。

表 3

第 1 組單元概念圖 v1~v4 之評分細目表

主題：三年級生活中的力				
項目	v1 中文版	v2 中文版	v3 中文版	v4 英文版
命題	28	25	25	20
階層	25	25	25	25
橫向連結	0	0	0	0
事例	7	8	8	8
總分	60	58	58	53

表 4

第 1 組單元概念圖 v1 之命題陳述與得分表

編號	命題陳述（透過「連結語」串接概念圖中不同「節點」所形成）	得分	評分理由
1	力產生（的）現象有沒有改變、形狀改變、與運動狀態改變化。	2	
2	力表徵於三要素包含作用點、方向、大小。	2	
3	力呈現的種類分為接觸力與非接觸力。	2	
4	力所產生的形狀改變分為可恢復與不可恢復。	2	
5	力所產生的運動狀態改變可能（是）變快、變慢、停止。	2	
6	力的作用點呈現於點。	2	
7	力的方向呈現於箭頭。	2	科學命題陳述正確且符合自然領綱之
8	力的大小呈現於線段長短。	2	中第二學習階段的學習內容指標。
9	非接觸力有磁力。	2	
10	接觸力有浮力。	2	
11	磁力能吸引鐵製品。	2	
12	磁力具有同極相斥異極相吸。	2	
13	浮力夠大（物體就會）浮在水面。	2	
14	浮力不夠大下沉。	2	
15	（力所產生效應中）沒有改變（的現象）例子為手推牆。	0	此為事例，故不列入命題計分。
16	（物體）下沉（之後若）改變形狀（就可以）浮在水面。	0	阿基米德原理表述不清，故不予計分。
總分		28	$2 \times 14 + 0 \times 2 = 28$

肆、研究結果與討論

一、iCM-BS 課程中概念圖知識結構的視覺表徵可協助師資生建立科學概念的邏輯關聯以掌握教材內容、檢核知識結構以適應教學活動

（一）iCM-BS 課程以圖形組織建立科學概念的邏輯關聯並協助新手師資生掌握教材內容

研究者依據 Novak 與 Gowin（1984）所發展的概念圖評分標準，對全班師資生所繪製不同階段的單元概念圖進行評分（詳見表 5），但因不同單元主題內容與性質不同，其科學概念與命題陳述的數量亦各異，故得分不適合組間比較。但同組師資生於不同教學階段所繪製同單元概念圖的得分變化則可顯示該組師資生知識結構改變的歷程。以第 2 組「多采多姿的植物」的單元概念圖 v1 ～ v2（詳見附錄）為例，由於該單元主要講述植物的構造與功能，所以相關科學概念及其對應的節點數量就明顯多於第 1 組「生活中的力」單元，故第二組各版本概念圖的得分皆高於第一組（表 5）。此外，表 5 顯示許多組別與第 2 組相似，其概念圖得分於 v1 與 v2 版本間存在極大差異，但第一組卻沒有出現類似情況。由於全班共 8 組，樣本數太小，且同組概念圖 4 個版本的重複檢測數大於 2，故本研究以無母數 Friedman 檢定分析全班 8 組師資生所繪製共 32 幅概念圖之得分數，將個別版本概念圖得分數進行組間平均後換算為等級平均數，續以表 6 顯示檢驗結果 $p = .005$（$< .05$）表示全班概念圖各版本得分間存在顯著差異，經配對比較（詳見表 7）後確認顯著差異之時序主要發生於 v1 與 v2 間。然而師資生所經歷的知識結構改變歷程與本研究教學活動間的關聯，須輔以質性的觀點深入探究，故研究者先從第 2 組概念圖的圖型組織進行觀察，發現其 v1 與 v2 版本概念圖（詳見附錄）的知識架構明顯不同：原本 v1（得分為 82 分，詳見表 5）係以「植物構造的功能性」為核心概念來發展知識架構，卻導致知識結構複雜因而無法有效統整該單元學習內容，造成命題數量較低且缺乏橫向概念連結，顯示課程初期該組師資生尚未能掌握該教材內容。但在與教師多次討論並逐漸掌握教材內容之後，則改以「植物的外部構造」為核心概念並重整知識架構，將「功能性」拆散分置於「植物構造」各分支架構下，從而有效統整該單元科學概念的邏輯關係、也提高了科學命題與橫向概念連結的數量，v2 版本的得分數因而大幅增加（165 分，詳見表 5）。由此可知「iCM-BS」課程能以圖形組織建立科學概念間的邏輯關聯並協助師資生掌握教材內容。

表 5

全班共 8 組所繪製各 4 個版本單元概念圖之總得分比較表

組別	主題	v1 中文版	v2 中文版	v3 中文版	v4 英文版
1	生活中的力	60	58	58	53
2	多采多姿的植物	82	165	143	136
3	奇妙的空氣	40	52	51	48
4	廚房裡的科學	51	62	62	61
5	田園樂	19	74	74	63
6	溫度變化對物質的影響	39	45	47	49
7	我是動物解說員	19	74	74	63
8	天氣變變變	29	36	37	31
	平均值	42.4	70.8	68.3	63.0

表 6

全班共 8 組單元概念圖 4 個版本得分之等級平均數的 Friedman 檢定摘要表

版本	v1	v2	v3	v4	*df*	X^2	*p*	Multiple Comparison
平均	42.37	70.75	68.25	63.00				
標準差	21.53	40.29	32.78	31.35				
等級平均數	1.38	3.25	3.25	2.13	3	12.789**	.005	v2 > v1; v3 > v1

註：** $p < .01$

表 7

第 1、2 組雙語自然教案的自然與語文領域學習目標

學生	自然領域學習目標	語文領域學習目標	
		目標字詞	目標句型
S1-1	能簡單分辨施力會使物體改變運動狀態或形狀；當物體受力變形時，有的可恢復原狀，有的不能恢復原狀。（Ind-II-9, tc-II-1）	push, pull, press, recover recoverable, unrecoverable	What happened when I (press/pull) the XX? The ____ will change the shape/ not change. What happened when I stop applying force on/press/pull the ____? The _____ can/cannot recover.
S1-2	能知道觀察、記錄實驗所得力的結果是有其原因的，並依據習得的力的表示法，說明自己的想法。（INc-II-3, tr-II-1）	magnitude of force, point of application, direction of force, the length of line segment, arrow direction	Can you try to explain the picture you drew? I drew the (point of application/ direction/magnitude) of force/here because _____.

（續）

表 7

第 1、2 組雙語自然教案的自然與語文領域學習目標（續）

學生	自然領域學習目標	語文領域學習目標	
		目標字詞	目標句型
S1-3	能透過觀察、操作發現磁鐵的兩極有同極相斥，異極相吸的特性。（INe-II-7, ah-II-1）	magnet, pole, like/unlike, repel/attract	What happened when you put the poles closely? I found the __ pole repels/attracts the __ pole.
S1-4	能從磁力相關資訊或數據，得到磁力有能吸引鐵製品的特性，藉以分離鐵粉與其他非鐵製品。（INb-II-2, pa-II-2）	magnet, attract, iron product	Magnet can attract iron product.
S2-1	能透過觀察認識植物的部位名稱，並簡單分辨。（tc-II-1, INb-II-6）	root, stem, leaf, flower, fruit, seed	The basic parts of a plant are roots, stems, leaves, flowers, fruits and seeds. These are (roots, stems, leaves, lowers, fruits, seeds).
S2-2	能從得到的資訊或數據，解釋植物體的外部形態（葉子），與其適應環境有關。（pa-II-2, INb-II-7）	leaf (margin, shape, vein, node, arrangement)	I classified leaves by (size/shape/color). (Pine/Fir/Coconut/Banana) leaves are (small/big) because the weather is and (dry/wet).
S2-3	觀察和分辨生活中常見植物的根的外部型態，並說明其生長、行為、繁衍後代和適應環境的相關性。（tc-II-1, INb-II-7）	roots (axial root, fibrous root)	_____ can help the plant _____. (Roots can help plants grab the soil.)
S2-4	能在指導下觀察常見植物的花，並運用想像力與好奇心，了解及描述其組成、特徵與功能等。（ti-II-1, INa-II-6）	flower (calyx, petal, stamen, pistil, pollen, nectar, pollination, reproduce)	This is_____ . _____ can help the plant _____. (Calyx can help support the flower)

（二）iCM-BS 課程有助於師資生檢核其知識結構以適應其教學活動

表 5 顯示全班 8 組單元概念圖得分的改變，多有下述類似現象：以 v2 版本得分數為基點，後續 v3 與 v4 版本得分則出現緩慢遞減的情況。以第二組單元概念圖的得分改變（82 → 165 → 143 → 136）為例，由於對師資生來說，期末依據教案執行 10 分鐘濃縮版微型試教是非常明確的任務目標，為達成教學任務必須精簡教學內容，因而使得 v3 中文版本與 v4 英文版本概念圖在陸續精簡冗餘的教學內容後，使命題總數逐漸減少而導致其得分數陸續下降（165 → 143 → 136）。研究者輔導師資生繪製概念圖與設定學習目標的過程中，也發現大部分新手師資生或因缺乏教學經驗、或因求好心切，在教案規劃初期常傾向於設定較大的教學目標，但陸續經

過反思、同儕討論與教師指導後則開始嘗試精煉與濃縮其教學內容。從師資生 S8-4 的期末反思即支持此觀點：

> 這次教學比較大的問題大概在教案寫的（範圍太）大，（教學）操作真的比較耗時，（教學活動）很難在十分鐘收完。其實包括中文占比很大的問題，很大一部份也是因為試教發現時間會嚴重超過，所以不得不把引起動機幾乎整個轉成中文以節省時間。

而另一位師資生 S3-3 也反應出類似看法：

> （一開始對於）要用雙語教學實在沒有信心，但在事前準備（概念圖和教案）有完善規劃也和同學老師互相討論（之後）有安心不少，希望可以不讓語言的障礙模糊這堂課的自然科教學重點。

以上證據顯示 iCM-BS 課程能有助於師資生檢核其知識結構以適應雙語教學活動。

綜上所述，本研究發現：iCM-BS 課程中概念構圖知識結構的視覺表徵可協助師資生建立科學概念的邏輯關聯以掌握教材內容、檢核知識結構以適應教學活動。

二、iCM-BS 課程中概念構圖知識結構的視覺表徵可協助不同背景師資生統整並設定雙語自然之自然與語言教學目標

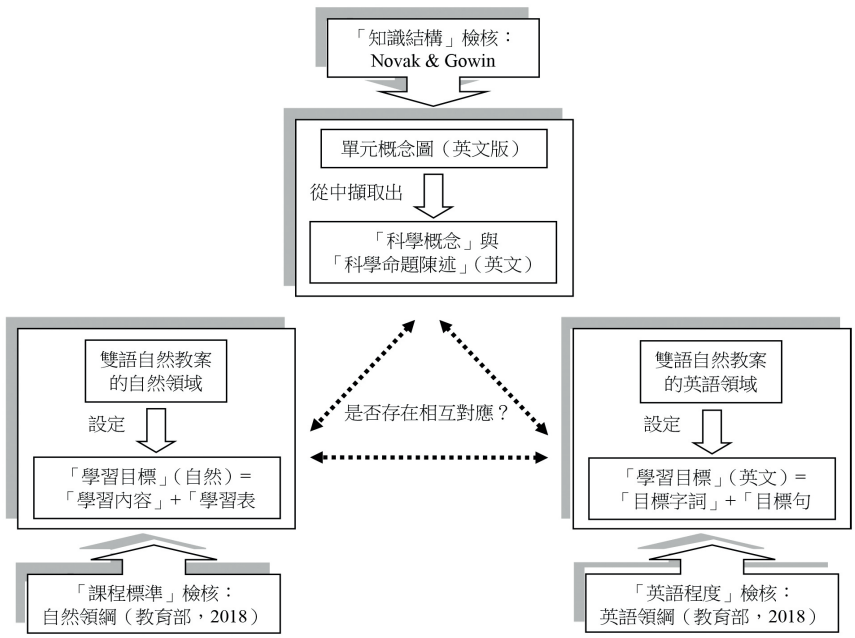
（一）iCM-BS 課程可協助師資生透過圖形組織統整自然與領域學習目標與英語目標句型

研究者從本課程中挑選不同背景（詳見表 1），包括就讀：自然相關系所（S1-3）、英語相關系所（S2-3）與教育相關系所（S1-1）等三位雙語自然次專長師資生作為個案研究對象，從其所屬組別之單元概念圖中的節點擷取出科學概念，將科學概念透過連結語形成命題陳述，復檢核命題陳述與「自然領域學習目標」及「英語目標句型」的對應關係（詳見圖 2）。以師資生 S1-1 為例，由第 1 組單元概念圖擷取出的相關命題陳述（詳見表 4）：「力所產生的形狀改變分為可恢復與不可恢復」，即能與其教案所設定的自然領域學習目標：

> 能簡單分辨施力會使物體改變運動狀態或形狀；當物體受力變形時，有的可恢復原狀，有的不能恢復原狀。（INd-II-9, tc-II-1）

圖 2

iCM-BS 課程以概念圖為核心的課程整合設計與資料說明



以及英語文領域學習目標（詳見表 7）的目標句型設定「What happened when I press/pull the __ ?」與「The __ can/cannot recover」相符合。研究結果顯示三位師資生在「概念圖命題陳述」、「自然領域學習目標」與「英語文領域學習目標之目標句型」等三個面向皆能相互契合。因此概念圖除了可透過圖形組織協助師資生掌握教材內容之外，其知識架構尚可成為英語文領域學習目標中挑選目標句型的參考，並確認其雙語教案能夠扣緊其學科內容之主題與教學目標。

（二）概念圖的知識結構可提供該單元統整規劃教學活動之依據

研究者檢視上述三位師資生自然領域學習目標與英語目標句型（詳見表 7）之後發現，其教案所設定的教學內容皆可對應於該單元概念圖（第 1 組概念圖 v1 詳見圖 1 的虛線框所示、第 2 組概念圖 v1 ～ v2 詳見附錄）知識結構中分支系統的科學命題陳述，例如；第一組「生活中的力」單元中的師資生 S1-3 以「磁力的現象」為主題所設定的自然領域學習目標「能透過觀察、操作發現磁鐵的兩極有同極相斥，異極相吸的特性（INe-II-7, ah-II-1）」，即可歸屬於該單元概念圖知識結構的「力——現象——形狀改變」分支、而師資生 S1-1 以「力所造成的形狀改變」為

主題則歸屬其概念圖的「力——種類——非接觸力」分支、師資生 S2-3 的教學主題「植物的根」則歸屬於該單元概念圖的「植物的構造——根——軸根／鬚根」分支。由此可知，單元概念圖知識結構的圖形表徵可以提供師資生規劃相關單元教學活動之參考依據。

（三）單元概念圖的節點可提供師資生挑選英語目標字詞的參考

由於三位師資生皆依據其單元概念圖的知識架構來設計教學活動，因此概念圖節點所代表的科學概念，也可成為英語文領域學習目標中目標字詞的合理選擇。以師資生 S2-3 的教學主題「植物的根」為例，其所設定的目標字詞（詳見表 7）為「roots、axial root 與 fibrous root」，顯然與其單元概念圖（詳見附錄）的相關節點「根、軸根、鬚根」完全對應；而師資生 S1-1 在教學主題「力的現象（形狀改變）」中所設定的目標字詞（詳見表 7）為「push、pull、press, recover、recoverable、unrecoverable」，所對照該單元概念圖（詳見圖 1）的相關節點則為「形狀改變、可以恢復、不可恢復」，其間亦存在明確的對應關係。以上證據顯示單元概念圖的節點除了可以協助師資生掌握教材內容之外，亦可作為英語目標字詞設定之參考。

綜上所述，本研究發現：iCM-BS 課程中概念構圖知識結構的視覺表徵可以協助不同背景師資生統整並設定雙語自然之自然與語言教學目標。

三、自然背景師資生對雙語教學的焦慮主要在英文的口語表達與學生的學習理解、英語背景師資生則是不熟悉自然領域的教材內容與專有名詞；但不同背景同儕間教材理解與教學經驗的分享卻可增進雙語自然教學活動構思與規劃成效。

（一）自然背景師資生對於雙語自然教學的焦慮主要在英文的口語表達與學生的學習理解，但 iCM-BS 課程中概念構圖知識結構的視覺表徵能夠協助並引導其完成雙語教學規劃：

受限於本課程的選修同學絕大部分來自於原開課系所，研究者只能依據該課程選修學生的就讀系所資料（詳見表 1）中挑選僅有的一位英語相關系所（S2-3）、再從三位非自然亦非英語（分別是藝術、中文與教育等三類）相關系所之中挑選了一位教育相關系所且具備六年的偏鄉國小自然代課教師經驗之師資生（S1-1），最後從原開課之自然相關系所中挑選一位師資生（S1-3）作為個案研究對象，以瞭解不同背景師資生於 iCM-BS 課程中的學習需求與意見反饋並作為課程改進之參考。但經課程後之深入訪談始得知，雖然 S1-1 當時係就讀開課學校之教育領域系所，

但之前曾擔任六年偏鄉小學的自然代課教師，且此前更已取得他校理學院的學士與碩士學位，始得知 S1-1 同時具備了自然與教育領域背景之身分。而從該生期末反饋資料得知其於雙語自然教學的困擾主要在於英語表達的流暢程度，S1-1 表示：

> 這一次試教演示是我第一次使用雙語，由於自身對於英語的使用比較缺乏信心，……，因此準備的過程中感到萬分的焦慮。

而同組的另一位師資生 S1-3 也認為：

> 因為沒使用過英語教學，對於三年級學生的英語程度也不太熟悉，雖然有盡量以簡單字句搭配手勢，仍會擔心無法讓學生理解。

至於師資生對於本課程的學習心得與意見回饋方面，S1-1 則表示：

> 雖然英語的使用仍是我還需要加強努力的地方，但透過刻意的練習課室英語、有邏輯的課程設計、跨語言的輔助與圖像化呈現、老師循序漸進的引導並完成課程規劃等等，即使透過不太流利的英語演示，仍是能將清晰呈現出教學的目標與想傳達出的科學概念，這無疑是大大增加自身對與雙語教學的信心。

而 S1-3 則認為：

> 對於課室語言及 Language for learning 的運用也需要再好好思考，什麼樣的雙語呈現對於學生來說是幫助他們學習的，而非造成他們的負擔，也能讓自己的教學更為順利。

從上述資料中發現：自然背景個案師資生對雙語自然教學的焦慮主要在於英文口語表達的流暢程度與學生對於英文口語的學習理解，但本課程能夠協助並引導其完成雙語教學規劃。

（二）英語背景師資生對於雙語自然教學的焦慮主要是不熟悉自然領域的教材內容與專有名詞，但是 iCM-BS 課程中概念構圖知識結構的視覺表徵亦能協助並引導其完成雙語教學規劃：

由於本課程中只有一位師資生 S2-3 具備英語領域背景，從該生期末反饋資料顯示該生對於雙語自然教學的困擾主要是不熟悉自然領域教材內容與專有名詞：

自從高中以來，許久沒有這麼深入地去碰觸自然領域，……，自然領域其實有很多特殊專有名詞，要如何在課堂中運用英文進行活動、解說，也是相當具有挑戰性。

而該生對本課程的回饋意見則是：

透過這次的課程設計與教學演示，自己對於雙語自然教學模式更清楚，……，特別感謝教授給予我許多（關於自然）教學建議，使我知道自然科學課的精隨（找到每個教學步驟與環節間的關係），讓我有明確的方向去規劃，並且相信自己有能力可以做到。

從上述資料發現：英語背景個案師資生對雙語自然教學的焦慮主要在於不熟悉自然領域的教材內容與專有名詞，但本課程亦能協助並引導其完成雙語教學規劃。

（三）不同背景同儕間對教材理解與教學經驗的分享可增進雙語教學活動構思與規劃成效

誠如前文所述，第一組單元概念圖 v1 ～ 4 版本得分的表現十分穩定（60 → 58 → 58 → 53）且明顯不同於其他組別（詳見表 5），由於第一組組員 S1-1 擁有偏鄉小學六年的自然教學年資，故十分熟悉自然課程的教材內容，因此在小組討論的過程中透過同儕分享使得該組其他同學從課程初期就已能著手構思該單元知識架構與教學活動之設計以符合期末微型試教時的教學需求，使其單元概念圖的得分表現十分穩定，該組組員 S1-2 的期末反思可支持此推論：

這學期的自然教材教法中，真的有學習到非常多關於實際層面雙語教學的應用，……，讓我對於課程的編排及構思，有非常多的長進，……，這個過程可以說是一個非常完整的實作體驗，我也非常感謝我的組員 S1-1，他總是有問必答，……，透過一起構思把問題解決。

另一方面，本班唯一具備英語背景的師資生 S2-3 所在第 2 組的組員 S2-4 也表示：

與同組夥伴一起共備課程時，因為每位組員的專業領域和性質都各有不同，

因此從（英語背景同學 S2-3）中也學習到很多有關於……英語在三年級雙語課堂中適用的詞彙、語句等，在設計教學活動時幫助我很多。

從上述不同背景師資生的期末反思顯示：本研究自然、教育與英語等三種不同背景同儕彼此之間對於英語使用、教材理解與教學經驗的分享可增進其雙語教學活動構思與規劃成效。

綜上所述，本研究發現：自然背景師資生對於雙語自然教學的焦慮主要在英文的口語表達與學生的學習理解，而英語背景師資生則是不熟悉自然領域的教材內容與專有名詞，但 iCM-BS 課程中概念構圖知識結構的視覺表徵皆能協助並引導其完成雙語教學規劃；然而不同背景同儕間對教材理解與教學經驗的分享則可增進雙語自然教學活動構思與規劃成效。

伍、綜合討論

一、師資生在 iCM-BS 課程中所遭遇的困難

由於 iCM-BS 課程的核心是概念構圖，師資生於本課程各階段教學活動中經教學者引導在反思、覺察與討論後繪製了單元概念圖並歷經 4 次修正。研究者在與其討論互動的過程中發現：雖然大部分新手師資生剛開始對於教科書的內容架構並不熟悉，但是概念構圖的過程促使其分析該單元的知識結構，而期末微型教學的備課壓力則督促其透過單元概念圖以快速掌握該單元共約 12 節課的教學規劃及彼此之間概念脈絡。研究者也透過師資生所繪製不同版本概念圖的圖形表徵，觀察到各組師資生對於該單元教學規劃的多元觀點與歷程改變，從而察覺各組師資生時常容易困惑於該單元不同的教學規劃彼此之間應該如何取捨？對此，研究者於 iCM-BS 課程中為師資生提供了二項建議：其一是回歸學習者本位的基本原則，從學童的學習需求出發來做判斷；其二是回歸課綱為本的雙語教學設計，檢視並選擇更符合自然領綱學習內容指標的單元概念圖來規劃該單元不同節次課程的概念脈絡。各組師資生在此原則下完成單元概念圖的定稿後，則是依據概念圖的重要節點選擇重要的科學概念，並將之轉化成英語文領域學習目標中的目標字詞，再從概念圖不同節點中提取科學命題陳述，並將之轉化為英語文領域學習目標中的目標句型。師資生在此階段所遭遇的困難則是：（一）部分科學概念欲作為該學習階段學童的英語目標字

詞顯然太過艱深（詳見附錄之圖 5）；（二）將某些科學命題陳述直接轉化為英語目標句型顯然太過冗長（詳見表 4）。對此，研究者亦在 iCM-BS 課程中向師資生傳達了與前述一致的理念：其一是回歸學習者本位的基本原則，其二是回歸課綱為本的雙語教學設計。但由於英語領綱係從英語文教學的角度出發進行規劃與編排，其發展背景尚未能考量到其他學科領域的雙語教學需求，故師資生在發展雙語自然教案並設定英語目標字詞與目標句型時，英語領綱較難發揮其預想的功能，這也是師資生在 iCM-BS 課程中所常遭遇的另一項困難。對此，研究者於課程中提供師資生暫時性的解套方案，則是再次回歸第一個原則，從學童生活環境與經驗中的英語詞彙入手，作為英語目標字詞與目標句型設定時的判斷依據。但是由於城鄉英語環境差異甚大，不同地區學童所能接觸到的英語詞彙各異，因而師資生所設計的雙語自然教案就會有適用性限制，這也是在 iCM-BS 課程中師資生所遭遇另一項無法克服的困難。

二、師培工作者在 iCM-BS 課程中所面臨的挑戰

依據教育部國民小學各師資類科教育學程之設計，師資生在選修各類科教材教法課程之後，依序尚有三週集中實習及半年教育實習等相關課程規劃。研究者在設計第一屆雙語自然次專長的雙語國民小學自然科學領域教材教法課程時，即是以該屆師資生未來三週集中實習所擬至之實習國小的學童作為本課程預設的學習者而進行教學活動的條件設定。但實際上國內不同學校雙語課程教學的實施型態各異：有可能是在原領域學科教學活動中實施雙語課程，也有可能依據各校特色發展校本位非主科的外加式雙語綜合課程，本質上兩者的教學重點、教學目標與概念脈絡都存在著許多差異。所以本課程 33 名師資生未來在半年教育實習階段勢必將面對各校雙語教學的不同型態。但是本研究 iCM-BS 課程係根據國小自然領域雙語教學的特性所發展，對於其他領域學科的雙語教學設計並不具備普適性，亦無法推廣至外加式的雙語綜合課程，這是研究者作為師培工作者在 iCM-BS 課程中所面臨的第一項且無法克服的挑戰。另外，由於 iCM-BS 課程的核心是透過概念圖將自然領域學科內容的知識結構（隸屬於自然領域的學習內容）與英語目標字詞與目標句型（隸屬於 L of L 所代表的「學科重要概念語言」），從「知識論」的角度（盧玉玲，2024）進行統整。但是以思考智能、問題解決與科學態度本質等自然領綱各向度學習表現指標為主軸的素養導向雙語自然教學就會偏向從「方法論」的角度（盧玉玲，2024）進行教學設計。這就不是單純以概念構圖分析學習內容的知識結構就可

以覆蓋，同時也是研究者在 iCM-BS 課程中所面臨的第二項挑戰：雖然自然科教材教法並不乏探究教學策略可供選擇，但是在學科雙語教學情境下，則會需要大量較高認知層次（例如：理解、應用、分析、評鑑或創造等）的「學習所需語言（L for L）」的相應師生英語對話，但這已超出本研究雙語國民小學自然科學領域教材教法課程的規劃範圍，本研究團隊未來將嘗試擬以課程協作的雙語師資培育模式探尋其解方。

陸、結論與建議

本研究結果顯示 iCM-BS 課程中概念構圖知識結構的視覺表徵：

一、可協助師資生建立科學概念的邏輯關聯以掌握教材內容、檢核知識結構以適應教學活動。

二、可協助不同背景師資生統整並設定雙語自然之自然與語言教學目標。

三、雖然不同背景師資生的學習需求不同，但同儕間教材理解與教學經驗的分享卻可增進雙語自然教學活動構思與規劃成效。

但研究者也於 iCM-BS 課程中遭遇前述若干的困難與挑戰，因而基於教學與研究觀察提出以下建議：

一、酌增課程時數：本研究原「國民小學自然科學領域教材教法課程」在被賦予了學科雙語教學任務而變成「雙語國民小學自然科學領域教材教法課程」之後，雖然教師的教學任務更加繁重，學生的學習負荷亦大幅提高，但是課程學分數與上課時數卻沒有任何變動。研究者除了在 iCM-BS 課程中以概念構圖法統整自然與英語領域的學習內容以降低師資生的部分學習負荷外，另外採取的臨時性折衷方案則是：盡可能地濃縮或刪減部分自然領域教學法的教學內容，將微型教學錄影與大量的觀課暨書面反饋等活動皆要求學生於課外自行進行，說課與議課活動則壓縮成為小組綜合討論的方式統整歸納。但為求學科雙語教育的長期發展，建議師資培育單位能夠思考適當增加學科雙語教材教法課程的學分數與上課時數以符合教學現場的實際需求。

二、師培課程協作：由於本研究「雙語國民小學自然科學領域教材教法課程」必須對自然與英語領域的教學進行整合，但若能進一步結合雙語師資培育的不同課程（例如：「雙語教學的理論與實務」）彼此間以協作模式進行統整，從師資

培育的角度上來說課程規劃的組織性更為嚴密，從授課教師的角度上來看課程間的分工則更為精細，最後從師資生的角度上來說，其所撰寫的教案亦可獲得各授課教師從不同專業角度上更多元且更全面的建議。

三、制定課程標準：本研究 iCM-BS 課程雖然可以透過概念構圖法統整自然與英語領域的學習內容，但仍亟需要相關的課程標準（例如：自然領綱）作為師資生設定自然領域與英語領域學習目標時非常重要的判斷依據。過去英語領綱的設計尚未來得及考慮臺灣的雙語教學需求，但未來若政府有持續發展雙語教學的長期規劃，建議應該針對雙語教學「拔尖且扶弱」的願景，設定雙語課程標準以利基層師培工作者穩健推展未來學科雙語教學的各項工作。

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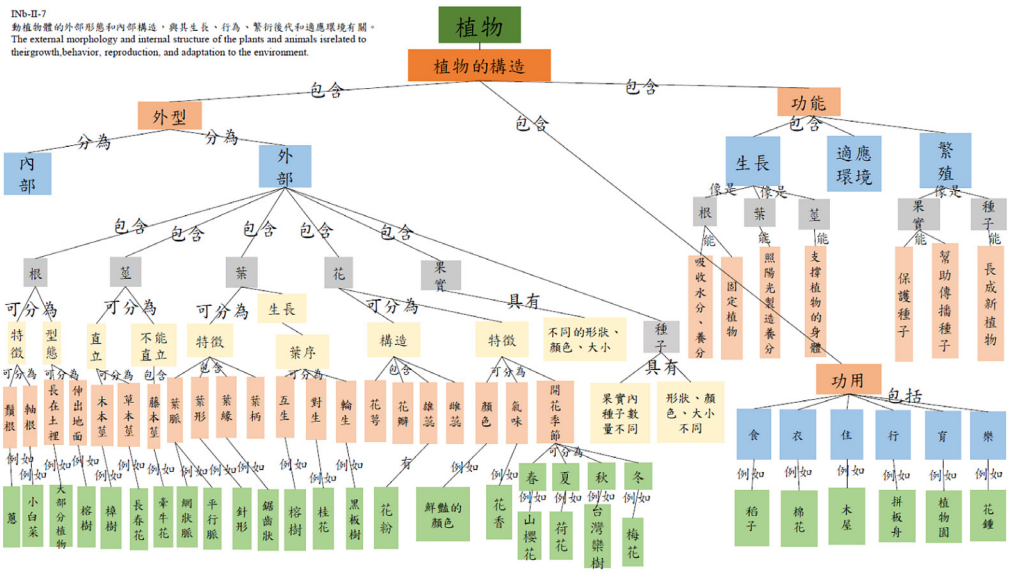
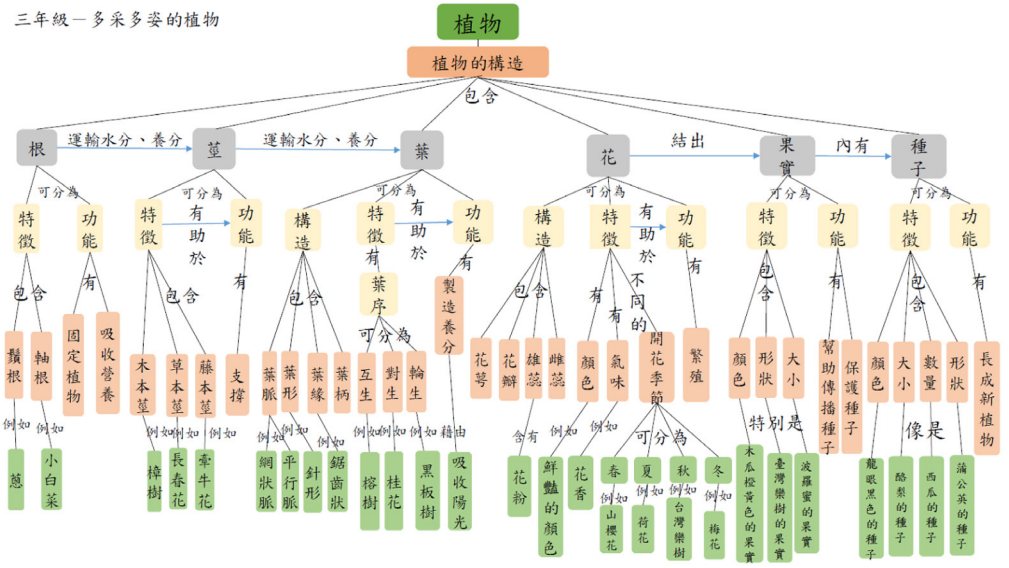
附錄

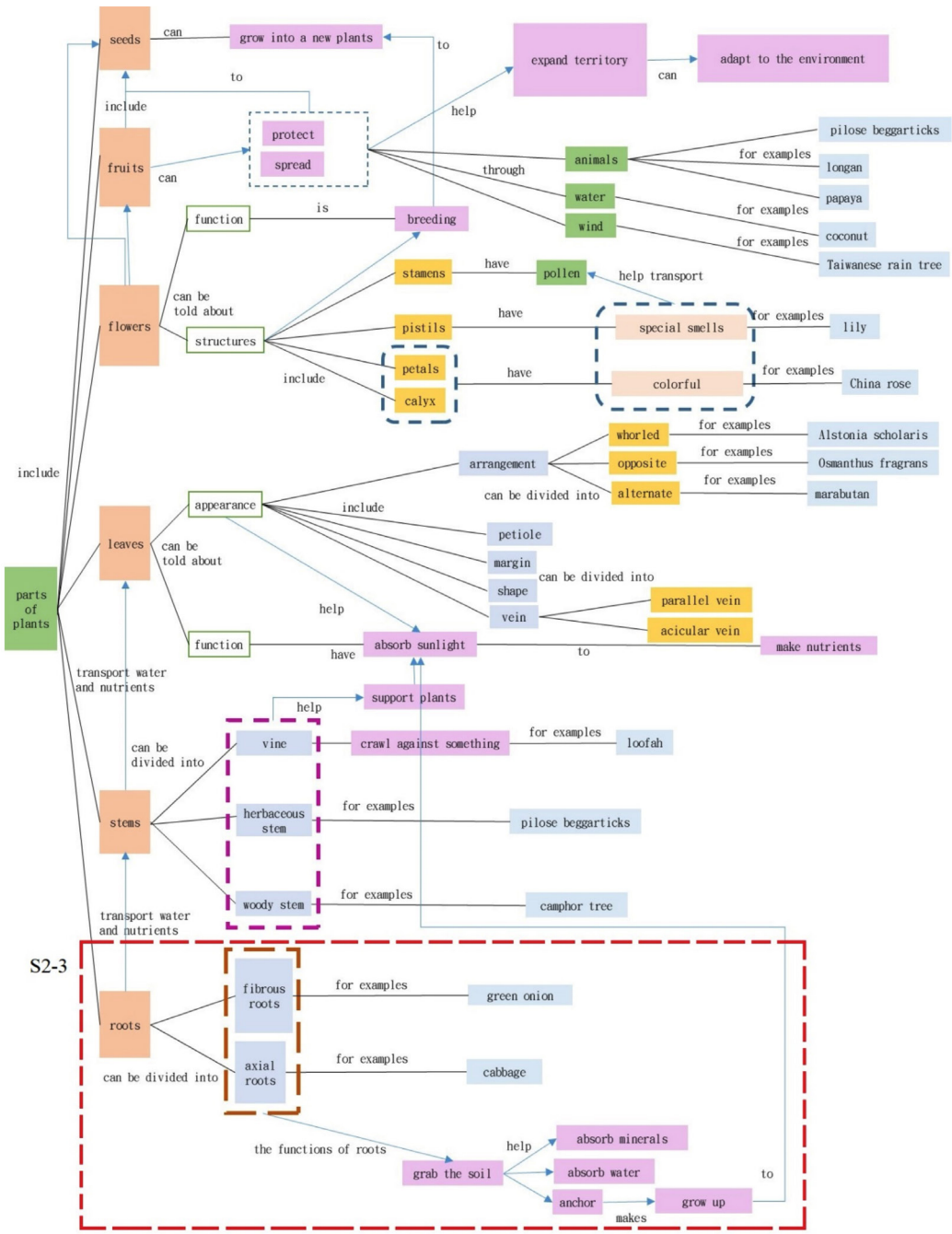
第 2 組 v1 版本之單元概念圖



第 2 組 v2 版本之單元概念圖



第 2 組 v4 版本之單元概念圖



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STEAM 融入戶外冒險之跨領域創意教學研究

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摘　要

戶外冒險教育融合跨領域知識的教學方式，能增加學習參與、知能擴展及專業能力，已是受到學生喜愛的學習趨勢之一。本文旨在探究一門「潛水、海洋文化與遊憩探索」跨領域課程中採用 STEAM 融入戶外冒險活動的教學經驗及成果。「潛水、海洋文化與遊憩探索」是一門 6 學分 18 天的密集課程，旨在透過海洋、文化、遊憩三要素，協助學生掌握潛水技能，並加深對海洋環境及生態影響的理解。本研究運用混合式研究法收集 14 位大學生的質性與量化資料，探討學生對 STEAM 學習、參與本課程後的心態與情緒商數，及對教學方式的反應等議題。研究結果指出：戶外冒險學習課程將成為高等教育發展的重要趨勢之一，證實戶外冒險活動融入 STEAM 跨領域知識是有效的教學策略。然而，因研究受試樣本數小，量化分析結果不具推論性，改善之道可考慮增加樣本數、活動類型、時程或次數等因素。此外，教育工作者尤應重視跨領域課程與素養的自我專業成長。本研究對高等教育中運用戶外冒險教育、STEAM 教學、或合併二者來增進學生的學習成效，提供重要的操作經驗及應用的參考資訊。

關鍵詞：心態、情緒、戶外教育、創新教學、體驗與冒險教育

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A Study on Interdisciplinary Creative Teaching for Outdoor Adventure Learning Blended into STEAM

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Abstract

Outdoor adventure education, blending interdisciplinary knowledge, boosts student engagement, cognition, and professional skills, gaining popularity. This paper examined STEAM integrated with the "Diving, Ocean Culture, and Leisure Exploration" (DOL) course. DOL is a demanding 18-day, 6-credit program with recreational, cultural, and oceanic components that aims to improve diving proficiency and broaden ecological awareness. Data from 14 students were analyzed using the mixed research method, which demonstrated the value of STEAM integration and outdoor adventure learning in higher education. However, limited sample sizes constrained the generalizability of quantitative findings, highlighting the importance of larger samples, diverse activities, and increasing schedules. Educator focus on interdisciplinary skills is recommended. This study provides practical insights for optimizing student learning outcomes through outdoor adventure education, STEAM, or their fusion in academia.

Keywords: mindsets, emotion, outdoor education, innovative teaching, experience and adventure education

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壹、前言

創意學習（creative learning）是一種積極教育（positive education）的形式，它涉及學習者內在心理（intrapsychological）和跨心理（interpsychological）的過程，為自己的學習與生活帶來新的、有意義的理解及貢獻（Beghetto, 2021）。學生透過個人的創意學習方式，能找出提高學習參與度和內容保留率的方法（ELM Learning, 2021），包括主動對學習的主題：提出問題、建立聯繫、想像是什麼、探索選擇及批判反思，為自己找出一個有創意且有意義的學習傳遞方式，來提升個人的學習參與度和成效（陳嘉彌、陳淑芳，2021；Craft et al., 2008）。當前人工智能的數位科技衝擊教學現場，已使學生難以適應與接納以「教師為主」的傳統教學。現代教師須具備善用科技及創新教學（innovative teaching）的能力，鼓勵、引導、建立及尊重學生的創意學習，才能提升他們在班級學習中的參與度和最佳的學習成效。

戶外冒險學習（Outdoor Adventure Learning, OAL）[1]結合了 STEAM（S＝科學、T＝科技、E＝工程、A＝藝術、M＝數學），是一種創新的教學方法。OAL 因具有玩樂、體驗、新鮮、刺激、好奇、挑戰、滿足等學習特質，很容易吸引學生參與其中，而獲得「傳遞學習」（delivering learning）的效果。特別是它具有豐富實務情境，涵蓋多元的學習議題，能滿足學生「提問、連繫、想像、探索、選擇、批判思考」的創意學習，更能吸引他們投入學習和增加知識的保留程度。OAL 雖非正規教育的主流，卻是一種有助於實踐學校教育目標的「另類替代教學法」（Karppinen, 2012）。儘管 OAL 尚未有提升「學業成就」面向的實證研究結果，但它在解決教師的教學困境（如教學成效低落、學生行為偏差等），加成學生的一般學習效果，卻獲得肯定（陳嘉彌、陳淑芳，2021；Poon, 2020）。此外，OAL 也具備綜合應用多元學科知識和技能的本質，它不僅是「跨學科教育」的最佳教學策略，也是創意教學中的重要媒介。

「跨學科教育」是當代教育思潮之一，目的是能更有效地培養跨域人才來解決當前複雜的問題及創新突破（Klaassen, 2018）。「戶外教育」與「跨學科學習」二者關係密切，戶外活動中充滿應用不同學科知識及技能的情境問題（Bunting,

[1] 「戶外冒險學習」與「戶外冒險教育」（outdoor adventure education）雖常被交互使用，但二者概念仍有差異存在，例如「戶外冒險學習」的使用範圍較廣，比「戶外冒險教育」更親近不同背景者的體驗和學習。學校教育中常將這二個名詞混合使用。

2006），其中即潛含許多與 STEAM 有關的內容。然而，國內在戶外教育中連結與應用 STEAM 跨領域知識的研究和實踐相當稀少，一般教師對此教學策略的認知亦感生疏。教師如能利用 OAL 的特性，便能吸引學生主動學習有關 STEAM 的知識和技能，滿足他們的創意學習需求，達到師生教與學的雙贏目標。

本文旨在分析一門將 STEAM 融入戶外冒險活動的跨領域課程——潛水、海洋文化與遊憩探索（Diving, Ocean Cultural and Leisure Exploration, DOL）——的教學經驗及成果，從中探究：（1）學生在 STEAM 上的學習成效與感受；（2）學生在學習過程中心態與情緒的改變情形；（3）學生對 DOL 課程及教學方式的感受；（4）STEAM 融入戶外冒險學習的教學反思等問題。研究結果對未來研究跨領域教育、戶外冒險學習、或結合二者之發展性策略等相關議題，能提供寶貴的參考資訊。

貳、相關文獻概述

一、戶外教育與 STEAM 連結能優質活化課程及教學

Learning and Teaching Scotland（2010）提出「戶外教育能優化現有課程與教學」的觀點，它重視「挑戰、享受、相關性、深度、全人發展和創新」的戶外教育，積極滿足了學生的學習需要（wants）及需求（needs）。戶外教育鼓勵師生以不同角度看待彼此、建立關係、提高自我意識和對他人的理解（Baird et al., 2020）；它透過冒險教育、環境教育、遊憩教育、「人和環境」關係，以及跨領域學科的知識內容，引導師生建構經驗、態度、知識及技能的感官學習（Priest, 1986）。戶外教育不僅能支援單科課程教學，也能協助二科以上的跨領域課程教學，其對實踐優化課程與教學的品質已得到教育機構的證明及肯定（Education Scotland Foghlam Alba, n.d.）。此外，戶外教育中的「體驗式學習」也是幫助學習者「改變」知識、思考、觀念、態度和行為的重要關鍵（Priest et al., 2000），它除有助於綜合應用和發展學科知識與技能外，也能激發正向心態及情緒經驗的轉移（溫卓謀、章勝傑，2018；Opper et al., 2014）。

STEAM 的教學本質是關於「提問、探索、觀察、實驗和預測」將要發生的事情（Sousa & Pilecki, 2018），學生在學習 STEAM 時自然地被引導出批判性思維、解決問題、合作與溝通、創造力／創新、社會技能等能力（Bertrand & Namukasa, 2020; Singh, 2021）；特別是在大自然中玩耍時，會發生許多「問題、探索、觀察、

實驗和預測」的情境，學生在不知不覺中也學習及應用了 STEAM 的知識；而教師也容易從「觀察」學生表現中，適時提出有關 STEAM 的進階問題和活動，指導學生利用「資訊工具」做深度的學習探索。此外，學生在戶外教育中也能因「自己——他人——環境」的密切接觸而獲得更多社會技能，例如同儕間合作、表達意見、遵守規範、自我控制、擔負責任、理解他人及同理心的學習機會。STEAM 融入戶外教育中不僅有助於學生學習跨領域學科的知識及社會技能，同樣地也能讓教師從 STEAM 教學中獲得創意教學的專業發展（Bertrand & Namukasa, 2020; Singh, 2021）。STEAM 在戶外教育中不僅扮演統整跨領域知識及活化學習的重要角色，而且比實施在教室內的學習價值及效果更好（Run Wild My Child, 2020）。戶外教育與 STEAM 相結合作為活化學校教學的策略也在澳洲研究中獲得肯定及支持（Gemmell, 2021）。

二、「選擇、玩、練習」之 CPE 教學模式

教師在戶外教育及 STEAM 中再加入「選擇（Choice）、玩（Play）及練習（Exercise）」的 CPE 模式，更能豐潤個人的創意教學。眾所皆知，「自由選擇是每個人渴望的機會及權力」（Dowding & van Hees, 2009），學生更視之為必然。「選擇理論」（Choice Theory）指出：教師需隨時注意學生會有選擇「滿足生存、愛與歸屬、權力、自由、樂趣」的需求；當學生缺乏選擇它們的機會時，容易出現偏差的行為問題。因此，教師需透過「個別談話」，幫助學生在當下做最適合的「選擇和決定」（Glasser, 1998）。戶外教育中有豐富多變的情境及問題，能滿足學生不同的學習欲望及需求，也最容易幫助師生得到「做出最佳選擇及決定能力」的教學和訓練（Bunting, 2006）。

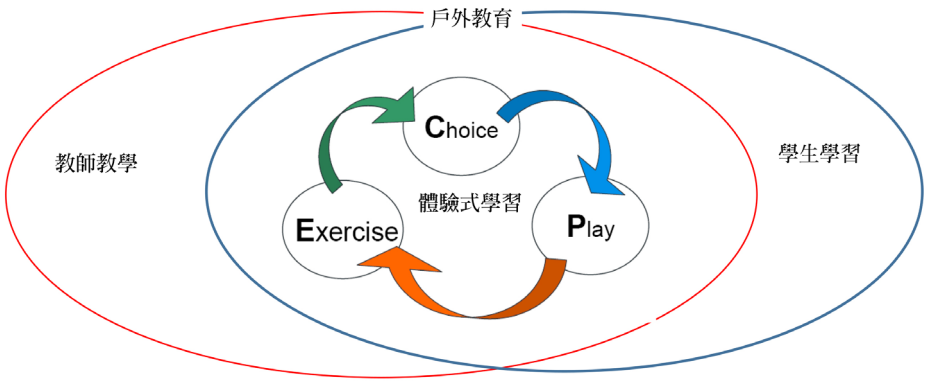
「玩」（Play）是建立學習行為與習慣的重要因素，Singer 等人（2006）即提出 play = learning（玩 = 學習）的觀點。Brown 與 Vaughan（2009）認為 Play 是天生的學習力，剝奪一個人的「玩性」，對其後續學習會有不利的影響。Resnick 與 Robinson（2017）更宣稱 Play 是終生學習的重要策略與方法。在戶外教育中，教師充分運用「自由玩（Free Play）→認真玩（Serious Play）→有目的地玩（Purposeful Play）」的 3P 概念與技巧，不僅能吸引學生的好奇和興趣，更能喚起他們的玩感與學習欲望，如不斷地練習及運動（exercise），則能培養出個人的「選擇力」及增加成功的機會（陳嘉彌等人，2024）。「玩」是學習的原動力；「不好玩」不易引起學習動機，也無法延長學習熱情和注意力。

練習／運動（Exercise）與學習成就關係密切。Ratey 與 Hagerman（2008）研究發現：Exercise 能改善個人的學習、壓力、焦慮、注意力不集中等狀況；建立 Exercise 的習慣不僅能增進身、心、大腦的生物關聯，也能促進學習認知、理解、記憶及創新的應用。Ratey 與 Hagerman 並做出「Exercise 能塑造和調節大腦，改善 EQ 及 IQ」的結論。戶外教育中有許多 Exercise 的機會，教師善用它們能協助學生累積自信、提升學習樂趣、精熟知識技能、靈活思考及展現正向的人格特質，而學生的這些特質也是促進教師推展優質課程及教學的重要養分。

上述可整合成一個 CPE 的創意教學模式（圖 1）：以「體驗式學習」為核心，透過「選擇」（Choice），投入「玩」（Play），強調「練習／運動」（Exercise）而成為師生間一項獨特且有效的教與學的方法（陳嘉彌、陳淑芳，2021）。無論是教或學，師生在交集的 CPE 模式中相互激盪出更多的「火花」，而達到「從戶外教育體驗中培養出創意教學能力」的目的。

圖 1

CPE 創意教學模式



資料來源：修改自陳嘉彌與陳淑芳（2021）。

三、學習的心態與情緒因素

Dweck（2006）提出固定型心態（fixed mindset）及成長型心態（growth mindset）的心態模式理論（Mindset Theory）。固定型心態指一個人完全信賴天賦會影響智商、人格特質、德性或表現；相反地，成長型心態指一個人相信透過努力、

學習與鍛鍊，能培養及改善個人的才能、性向、興趣或個性等素質。不同的心態會產生不同的表現，當碰到挑戰或失敗時，固定型心態者容易表現出批評抱怨，傾向逃避、放棄或關閉再嘗試的行為；而成長型心態者則視它為另一種學習的開始，會產生再努力學習的動機和熱情。隨著時間推移，具成長型心態者的表現更可能勝過固定型心態者。Dweck 主張學生需克服固定型心態的迷思，增強成長型心態，便能在學業成就上得到進步的表現。Dweck 的心態模式理論在不同領域的實證研究中也獲得了支持與肯定（陳嘉彌，2020；Coppersmith et al., 2022）。

絕大多數人的心態多「擺盪在固定型心態與成長型心態之間」，因此「如何改變固定型心態為成長型心態」便受到關切。Dweck 提供促進成長型心態的四點步驟：（1）傾聽自己的「聲音」；（2）承認有「選擇」機會；（3）用「成長型心態」的聲音回應對話；（4）即時表現「成長型心態」的行為，可以削弱固定型心態的表現（陳嘉彌，2019）。戶外冒險教育恰能提供這四點步驟的體驗及訓練，而達到增強「成長型心態」的效果。此外，因戶外冒險教育具備情境、人際合作及風險等因素，使原本可能會出現逃避挑戰、輕易放棄、不願努力、拒絕糾正或忌妒等固定型心態，反而容易產生被隱藏、弱化、短暫消失，甚至改變的效果。戶外冒險教育最珍貴的學習價值之一，就是能激發參與者的成長型心態及學習改變（Salzman et al., 2019）。此外，它也有提升情緒商數的效果（Opper et al., 2014）。

「情緒商數」（Emotional Intelligence Quotient, EQ）是指感知、理解和管理自己的情緒和人際關係的能力；它涉及意識到自己和他人的情緒，並利用這種意識來指導個人的思維和行為（Frothingham, 2024）。學者對組成 EQ 的內涵多以「情緒」為重點（Petrides et al., 2007）。個人不僅需要覺知自己的情緒起伏，能自我調適與激勵，而且也要能「辨識、接受及理解」他人的情緒，並能以同理心和社交技巧表達情緒。「情緒」能影響個人與他人的相處關係及幸福感，它在學習或工作中也會影響了自我效能和結果（林仁廷，2020；陳李綢，2008；Saheer, 2021）。

測量 EQ 大多採用「自我陳述」情緒狀態來判定 EQ 的評價，因此有許多「情緒商數量表」的版本出現。Konstantinos V. Petrides 設計的「情緒商數特質問卷」（Trait Emotional Intelligence Questionnaire, TEIQue）較被各國學者與專家接受，並有多國譯本提供作為研究學生、邊緣青少年、職場員工、成人或老人等情緒商數的調查工具。

TEIQue 的原始設計是 Konstantinos V. Petrides 博士論文中 153 題的長版問卷，經不斷地修正後，調整為 30 題的短版問卷（TEIQue-SF），分成四個因素（Petrides & Mavroveli, 2018）：（1）幸福感；（2）自我控制；（3）情緒表達；（4）社交化。Schwartz 與 Belknap（2017）利用 TEIQue-SF 檢測戶外教育對 EQ 的影響，發現戶外教育能提升參與者 EQ，並正向影響其社會表現及學習成就；但是戶外活動設計如內容單一、期間（時間）過短、參與人數較少，則未必會呈現增益 EQ 的結果。再者，即使採用不同的 EQ 調查工具（如 Emotional Intelligence Experience Questionnaire, EIEQ），大都也支持戶外冒險教育活動有助於提高參與者 EQ 的水準（Hayashi & Ewert, 2013）。

四、創意教學體驗及實踐

教師與學生在創意教學中會表現出五個關鍵特徵：（1）提問與挑戰：師生相互提問，鼓勵學生接受挑戰；（2）創造連結與發現關係：學生從「溫故」中創造「關係連結」，從中得到「知新」；（3）設想可能情況：鼓勵想像或預判選擇可能得到的結果、問題或挑戰；（4）探索點子與保持彈性：鼓勵發揮想像、實驗、信任直覺、克服困難並落實想法，成為有創意和想像力的人；（5）培養省思與批判思考的習慣，成為務實的創意學習者（Burnage, 2018）。在戶外教育中，師生最容易體驗與實踐這五個關鍵特徵，特別是在好玩、冒險因子較高的戶外冒險情境中，更容易激發創意教學的動機和潛能。

連結戶外教育及 STEAM 仍重在「體驗式學習」的創意教學。「創意教學」應是當代教師的重要專業能力之一，原因是：現在的學生早已能用手機、電腦及網路，以「玩」的「自學」方式學到想學的東西（Zur & Zur, 2011）。亦即，教師的傳統教學角色與教學方法已無法滿足現在學生的需要和需求。教師若只意識到「學生為主」的教學觀念，卻不知有效操作「學生為主」的教學法，最後可能仍是師生雙輸（lose-lose）的狀況。

師生「共玩與共學」是解決這個問題的最佳方法之一。教師在戶外教育中應用 CPE 教學策略，感受「玩＝學習」的樂趣與真諦，才可能將所領悟的「創意學習」經驗轉化成「創意教學」的方法，從中改變學生對「教室學習是無趣的、無效的」態度，進而使他們重新接納教師的教學，並引導出他們的創意學習表現（陳嘉彌、陳淑芳，2021；Singer et al., 2006）。Burnage（2018）提出教師引導學生「創意學習」的竅門，包括：（1）開放式作業，給學生更多的學習選擇機會；（2）小組共學，

激發創造性思維及交流；（3）藝術融入教學，鼓勵學生以發揮想像及趣味的方式表現教與學；（4）鼓勵學生寫作，隨手記錄「聽說讀想」提升思想力；（5）腦力激盪，包容不同意見和想法；（6）廣泛應用網路教學資源，作為創意學習的工具；（7）鼓勵冒險，面對失敗及增強問題解決的能力和自信；（8）打造靈活的課堂情境，突破傳統的課堂時間規範及學習環境。戶外教育中，教師最容易實踐 Burnage（2018）的創意教學竅門，不僅使學生獲得創意學習的最佳學習效果，同時他們也得到為自己學習負責的空間與機會。

參、研究方法與材料

本研究採「混合式研究法」收集與分析資料。晚近探究戶外教育議題中已視此方法是一項重要趨勢，原因是研究者藉由貼近參與者之便，而能精準地描繪及分析他們在戶外活動中的真實反應和變化情形（Gilbertson et al., 2022）。混合式研究法擷取質、量化研究之優點，使研究問題能得到：（1）三角檢視資料的一致性；（2）質性與量化資料的對照與補充；（3）發現開創的現象（陳嘉彌、陳淑芳，2021）。茲將本研究之跨領域課程設計、實施對象、研究問題、資料收集分析等分述如下：

一、跨領域課程設計概要

「潛水、海洋文化與遊憩探索」（DOL）為一所大學為大二以上學生設計之 6 學分跨領域課程，採 18 天密集式教學。課程主軸是潛水，搭配主軸的是綠島的海洋生態及地方文史，並融入 STEAM 的學習內容。上課時間在暑假末端，至開學前結束。課程屬性是「戶外冒險活動兼具跨領域知識和技能的體驗學習」，設計理念基於：（1）冒險方案長期（如以「年」計）或集中一段較長時間（如密集一周以上）持續實施，較能實際發揮它的教育影響（Rosenberg et al., 2014）；（2）初階潛水技能採密集式學習，且在海洋中操練，學生能達到更佳的學習效果（Porter & Shucksmith, 2015）；（3）教學利用跨領域學科方式能促使學生獲得「學以致用」的信心及體悟（林冠宇，2019）。

DOL 目標是透過「海洋」、「文化」及「遊憩」等三個要素幫助學生學會潛水知識和技能、領悟保護海洋環境及生態、對地方文史的認識與了解。教學場域以「綠島」為主，它是休閒潛水的最佳教學場所。DOL 教學內容採 STEAM 的概念

設計：（1）S（科學）著重綠島當地海洋生態系、珊瑚生物（礁）、海洋環境問題、碳循環與氣候對珊瑚礁影響等知識的學習；（2）T（科技）著重熟練潛水知識、技能和裝備，例如潛水浮力補償裝置（BCD）、潛水氣源供應原理與運作、浮力潛水裝備操作、潛水電腦表資訊應用等；（3）E（工程），因與 T 高度關聯，故合併到 T，稱為 TE（技工）；（4）A（藝術）著重學習過程的寫作及影像製作，包括省思紀錄、水中攝影技巧、剪輯及故事創作等；（5）M（數學）著重熟練「潛水」時計算三角及四角導航角度、潛水深度的每分鐘耗氣量、休閒潛水計畫表（RDP）使用方式、氮氣半飽和及趨近飽和的時間等。簡言之，DOL 中潛水以 TE 及 M 為主，海洋文化以 S 為主，遊憩以 A 為主，共組成跨領域知能的學習體驗課程。

DOL 由四位專業教師協同教學：W 師專長戶外教育，負責潛水教學，為 DOL 的主要規劃人。D 師專長海洋生態研究，負責教授綠島附近海洋生物與環境的知識。Z 師專長社會及文化研究，負責有關文化及遊憩體驗活動。H 師專長數位媒體設計，負責透過傳媒製作呈現出海洋生態與文化的學習成果。W 師為 DOL 協同教學負責人，主要採用 Burnage（2018）的創意教學策略引導及評量學生的學習成效，其餘專業教師在課程中互相協作，執行各自的專業角色。

二、實施對象

DOL 教學活動因具較高風險性，為確保人員安全而有修課人數限制；另因是新學期開學前的密集課程，學生須願意犧牲假期及接受密集學習的抗壓性，因此要透過「面談」挑選能適應的學生。最後確定 17 名修課人數，其中女生數多於男生將近一倍，大四生最多，大二生最少；師範學院人數多於人文學院及理工學院學生（表 1）。完成全部質量化資料調查的學生才作為本研究的分析樣本。17 名學生中有 3 名因提供資料不全緣故而刪除，資料完整之有效樣本有 14 名。

表 1
修習 DOL 學生之背景百分比

背景	性別		年級			學院		
	男	女	大二	大三	大四	人文	師範	理工
百分比	35%	65%	24%	35%	41%	17%	65%	18%

n=14

三、研究問題

根據研究目的、文獻概述及 DOL 跨領域課程之實施，提出四點研究問題：

（一）學生學習 STEAM 的感受與成效變化？

（二）學生參與 DOL 後的心態及情緒商數變化？

（三）學生對 DOL 教學方式的學習反應？

（四）教師對 DOL 的教學反思？

四、資料收集與分析

（一）根據 DOL 內容自編「STEAM 融入體驗冒險活動之教學實踐」問卷，共 25 題，包括：（1）基本資料 3 題：性別、年級、所屬學院；（2）對 DOL 教學方式的學習感受 6 題：如密集課程接受度、好玩、挑戰、學習投入、作業認真、改變等，填答反應等第從 1 ～ 10 的「正向強度」；（3）S、TE 合併、A、M 等學科專門知識內容，共 16 題，填答反應等地從 0 ～ 9 的「熟悉程度」。本問卷之資料主要回答研究問題一及研究問題三。

（二）心態調查採用美國 National Council for Community and Education Partnership 根據 Carol Dweck 理論編製的「心態模式測驗問卷」（Mindset Quiz），共 20 題，包括「成長型心態」與「固定型心態」，各 10 題；反應等第從 0 ～ 3 的同意程度，它的優點能明確地區辨成長型心態與固定型心態，且固定型心態分數可反向計分並與成長型心態併為「正向心態傾向」的變項（陳嘉彌，2019）。本問卷之資料主要回答研究問題二及研究問題三。

（三）情緒商數調查採用 Konstantinos V. Petrides 之「情緒商數特質簡易短版問卷」（TEIQue-SF），它已區分為四個因素：幸福感、自我控制、情緒表達／反映、社交化及整體情商特質等共 30 題；反應等第為 1 ～ 7 的同意程度。TEIQue-SF 已翻譯成多國版本，廣泛被相關領域使用（Petrides & Mavroveli, 2018）。本問卷之資料主要回答研究問題二及研究問題三。

上述問卷均採「網路問卷」進行「前、後測」填答。DOL 第一天上課時施行前測，課程結束時實施後測。數據由網路下載轉成 SPSS 資料檔，利用描述性統計、Paired Sample *t*-test 及 Pearson 相關分析呈現量化分析的樣態，它們不做推論使用，而在於提供描述參與者改變的結果。此外也收集學生的質性資料，它與量化分析結果互為對比解釋。收集質性資料的工具包括：

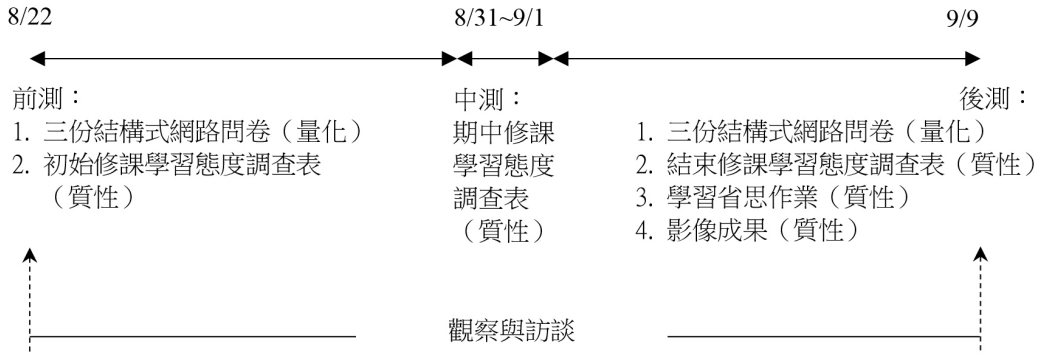
（一）「學習初、中、期末修課學習態度調查表」，書寫有關 DOL 之學習「什麼、幫助、方式、準備、境況、改變、及自評」等七項開放性問題。填答者於初始、期中、結束等三個時間點，使用同一份卷分別以期望（初）、現在進行（中）、完成（結束）等時態回答各個問題。

（二）學生的省思心得、影像成果作業，及作者的教學觀察、與學生對話、省思等紀錄。質性資料採主題式分類、描述及分析討論，並從其中整理出簡易百分比數據，以輔助歸納質性資料的陳述結果。

收集質性及量化資料的時間點及項目如圖 2。研究問題一至三之資料分析係採混合式研究法中「先量後質」（Tashakkori & Teddlie, 1998）的方式進行分析，質性部分根據量化結果進行資料歸類與分析，二者結果相互比對或補充說明；研究問題四則針對教師實施 DOL 教與學之成效，進行整體的反視、反省及討論。

圖 2

收集質性及量化資料時間點及項目



肆、研究結果與討論

一、研究問題一：學生學習 STEAM 的成效與感受變化

（一）量化資料

學生在科學（S）、科技與工程（TE，簡稱「技工」）、藝術（A）、數學（M）等學習項目之前測與後測的熟悉程度變化情形（表 2）：

1. 前、後測分數之「相關分析」發現，僅藝術達顯著，其餘項目均無相關性存在。絕大多數人普遍喜愛藝術，其前、後測間呈現正相關性是可被理解的現象；但科學、技工、數學等前、後測分數皆未呈現出顯著的相關性，此正顯示後測分數大於前測時，具有正面學習進步的改變涵義。
2. 前、後測分數之「平均差」發現，Paired-*t* 值均達顯著水準，數學進步最大，其次是技工、藝術、科學等均有進步。
3. 後測分數發現，技工的「平均數」最高，其後依序是科學、數學、藝術。
4. 前、後測的分數範圍（range）發現，前測時有「陌生」（0）的反應，如技工、藝術、數學等三項，但後測時，各學習項目皆已有不同的熟悉程度。

表 2

STEAM 融入 DOL 前、後測學習感受分析結果

學習項目	前測		後測		Paired-*t* 值	前測 - 後測平均差（排序）	前測 - 後測 Pearson's *r*
	X（*SD*）	range	X（*SD*）	range			
科學（S）	21.14（5.23）	12-31	29.00（2.51）	24-33	-5.21***	-7.86（4）	.07
技工（TE）	15.3（11.03）	0-36	31.21（2.51）	26-35	-5.79***	-15.85（2）	.41
藝術（A）	14.36（9.54）	0-30	25.21（5.75）	13-33	-5.68***	-10.85（3）	.67**
數學（M）	8.57（7.48）	0-24	25.36（3.27）	20-31	-8.11***	-16.79（1）	.14

n=14　**$p < .01$.　***$p < .001$.

（二）質性資料

學生 STEAM 學習成就之後測分數明顯大於前測，支持了 Lloyd（2018）的研究發現：戶外教育取向的 STEM 教學能影響學生的學習態度及學業成就。質性資料中，所有學生也感受到 DOL 中確實需要具備跨領域知能，才能在陌生、有吸引力的海域中安全地潛水，享受海洋生態的學習、樂趣、驚奇和成就感。他們分享 STEAM 的學習時表示：

> **我在上課之前沒有想到一項活動背後有這麼多的科學知識**，從潛水裝備的設計及使用，就能讓人知道科學原理的實際運用……下水後，運用物理的知識

可以確保潛水安全，這也是我沒有想到的……**潛水與跨領域知識還蠻密切的**：有關科學的包括物理，像壓力、氣體計算，如何看天氣、海象等，還有認識海洋生態；有關科技的是潛水裝備的實際運用；數學方面，要學會制定自己的潛水計畫。藝術方面，在海底用不同角度進行水中攝影的資料收集，及拍出好看的照片。（F9101，期末分享報告[2]）

本次課程涉及很多領域的學習及應用。科學（S）包括潛水物理學、生物學……科技（T），潛水運用了電腦表幫助計算減壓時間、最大深度及三分鐘停留時間倒數……工程（E），利用中央氣象局遙測系統的氣象資料、潛水裝備裡也須利用 BCD 等系統……藝術（A）包括攝影與影像剪輯技術，記錄這 18 天在陸上、海下的畫面，並呈現帶有故事或有意義的影片內容……數學（M）計算減壓時間尤為重要……下到多少深度需要減壓多少、餘氮時間的多寡、判讀計畫表等都需要用數學做計算。（F0004，期末分享報告）

水肺潛水是一種潛水的器具……透過呼吸調節器及氣瓶供氣（80% 氮氣 +20% 氧氣），讓潛水者在水中可以呼吸，做長時間的潛水活動……**潛水本身就包含到科學、技術、藝術、數學的連接**。（M1124，期末分享報告）

海洋生態探索先教珊瑚的知識。**一開始我對珊瑚不了解，也不知道它有那麼多種類，我只知道要保護珊瑚，但不知道保護它的原因**。上了這門課，讓我從理論及實際潛水體驗中，才對珊瑚生態的重要性有更清楚的理解……**除珊瑚外，還學習其他海洋生物的知識，特別是海龜和熱帶魚種**，對它們有一種神奇的感覺和認識……這門課程中我學會影片剪輯及水中攝影這項重要技能……**在課程結束後我會繼續鑽研這項功課**。（F5105，期末分享報告）

不是所有學生能像上述學生具體地說出在 DOL 中 STEAM 的學習連結與收穫，但是從相關回饋中，都能看到他們感受到「跨領域學習」的收穫感。例如：在第三次的「修課學習態度調查表」中，F7068 表示：「我已學到了許多有關潛水的基本知識及保護海洋環境的具體作法，並能親身去實踐。」F5126 表示：「我已熟知潛

[2] 質性資料代碼，「F9101，期末分享報告」表示「女性，9101 號學生，期末分享報告」。男學生則以 M 表示。其後表示皆同。

水技能、環境保護議題、生態攝影等相關知識。」儘管部分學生較缺乏系統地表達跨領域的學習內容，但對照量化分析結果，可確定他們跨領域知識的學習是進步的。

總括觀之，DOL 的 STEAM 學習中，數學進步幅度最大（平均差 =-16.79），其次為技工，這二項知識關乎個人潛水安全，學生自然地特別重視。藝術學習也有進步，這與水中攝影、影像剪輯等趣味及創意活動有關，受到學生喜愛。科學進步幅度雖最小，但因在 STEAM 前測時的分數最高，標準差最小，導致後測時進步幅度相對地較少（見表 2）。整體而言，DOL 中 STEAM 確實發揮了教與學的作用與效果。

二、研究問題二：學生的心態及情緒商數的變化

（一）量化資料

學生在心態——成長型心態、固定型心態及和正向心態傾向，及情緒商數——幸福感、自我控制、情緒表達、社交化與情緒商數總和等部分，前、後測分數變化情形：

（1）由心態的前、後測分數之「相關分析」發現，僅正向心態傾向達顯著正相關，而成長型心態與固定型心態無相關性存在（表 3）。在前測時，成長型心態與固定型心態間無顯著的相關性（r = -.29, p = .321），但後測時，二者不但呈現顯著的負相關性（r = -.69, p = .007），且成長型心態分數（X = 21.21）明顯高於固定型心態（X= 12.07）。顯見 DOL 結束後，學生的固定型心態看似未改變，但成長型心態出現成長變化的現象，並提升整體正向傾向心態的表現（參考表 3，前、後測的平均數及 range 變化）。

（2）由表 3 的心態「平均差」發現，成長型心態、固定型心態或正向心態傾向之前、後測在 Paired t 檢驗中均未達顯著差異，但成長型心態與正向心態傾向的後測分數仍略高於前測，固定型心態則沒有變化。

（3）由表 3 的幸福感，自我控制、情緒表達、社交化或整體情緒商數等前、後測之「相關分析」發現，僅幸福感未達顯著差異，其餘均呈現不同程度的正相關性。Paired t 檢驗前、後測分數之差異雖都未達顯著水準，但幸福感、社交化之後測分數略高於前測，而自我控制、情緒表達之後測分數則略低於前測，整體情緒商數之後測分數仍略高於前測。此顯示，本課程不會導致學生的情緒商數受到負面影響，而有退步的跡象。

表 3

學生參與 DOL 密集式學習之心態及情緒商數前、後測感受分析結果

題項	前測		後測		Paired-*t* 值	前測 - 後測平均差	前測 - 後測 Pearson's *r*
	X	range	X	range			
成長型心態	20.50	14-25	21.21	16-27	-0.81	-0.71	-.39
固定型心態	12.07	7-18	12.07	5-18	0.00	0	.51
正向心態傾向 [a]	38.43	26-47	39.14	29-52	-0.56	-0.71	.60*
幸福感	30.07	21-36	30.86	20-36	-.60	-.79	.41
自我控制	27.64	19-34	27.50	19-34	.12	.14	.62*
情緒表達	38.93	29-49	38.64	31-51	.25	.29	.76**
社交化	47.43	34-62	48.79	32-60	-.87	-1.36	.67**
情緒商數總和 [b]	144.07	119-178	145.79	102-178	-.55	-1.72	.77***

[a]「正向心態傾向」為固定型心態反向計分後，與成長型心態分數合併成。

[b] 情緒商數總和 = 幸福感 + 自我控制 + 情緒表達 + 社交化。

n=14 *p < .05, **p < .01, ***p < .001

（二）質性資料

從質性資料分析，能發現學生的心態與情緒有明顯的變化。由於 DOL 中的「水肺潛水」是較高風險活動，加上是暑假密集課程，因此修課學生都是通過課前「面談」的學生：八成是潛水初學者，二成曾有「休閒潛水」的經驗；基本上，他們具有穩定、積極的心態及情緒。例如，F9101 回憶修課前、後的心態和感覺：

> **修課前，情緒是期待和緊張**……期待的是，這是我第一次潛水與海水有親密的接觸……認識綠島的海洋休憩和文化資源……緊張的是，從沒嘗試過相關的海洋遊憩活動，游泳能力弱，對海洋環境也陌生……此外，**18 天的密集課程真的好長，很擔心撐不下去**。
>
> **課程結束後，覺得最不可思議自己居然能完成這 18 天課程，我成功地潛下水了**……過程中雖充滿難阻、挫折和失敗，但還是堅持下來，覺得很有成就感。（F9101，期末分享報告）

F9101「期待、緊張、接受挑戰、堅持投入、不服輸及成就感」的心態與情緒，代表了絕大多數修課學生的反應（R 省思札記 15）[3]。學生在整個過程中都抱持「正

[3] 質性資料代碼。「R 省思札記 15」代表「作者第 15 次的教學紀錄、反思及發想的紀錄」，其後表示皆同。

向心態傾向」，即使不時地會出現「疑慮、擔憂、害怕」的情緒，但隨著上課時間的推移，「相信自己、學伴協助、信任教學」的堅定心態，克服了密集課程的學習壓力，許多學生表示學習成果出人意表：

> **課程是密集的步調，當中突遇到「海葵颱風」攪局**，便打亂了原有的課程計畫，**使得學習時間變得緊湊，壓力變大**……但是看到老師、助教和同學都積極相互協助……而有信心面對之後的挑戰……**課程結束後，自己心態有所成長**，不再像過去那般主觀……願意去傾聽、理解不同的看法……這也是我從課程中意想不到的收穫之一。（F5126，期末分享報告）

> **密集式學習中最深的感受是要「保持專注」**。不僅是學習潛水……而且做任何事、學任何東西都應該保持專注。「專注」讓我們更容易吸收知識，也能減少出錯的機率，這是從 [綠島] 潛水中的體悟。**「潛水」是……高風險活動，面對它要保持良好的心態和情緒**，反覆與潛伴「討論、糾錯及練習」潛水技能……有耐性、同理心和他人溝通，才可能安全地享受潛水世界的樂趣……**這門課程也讓我學會：未來跟人溝通時，要有效地表達自己的意見想法，以減少誤解及差錯**。（M8115，期末分享報告）

> 「**更勇敢地提問、更熱情地學習**」……我很喜歡分組學習中一起煮飯的氛圍……從 [煮飯] 活動中相互關心對方，很容易地熱絡起來，**在密集課程的心理壓力下，更能凝聚及克服學習的惰性與挑戰**……自我控制力，尤其在面對 [潛水時] 壓力、緊急或危險時，學會要保持冷靜……做出最佳的決定。**這種自我控制技能在生活中其他類似的情境中同樣地受用**……與潛伴一起下水時，也讓我對「傾聽、考慮他人的感受、顧及他人情感和需要」有更多的體悟和操練。（F7116，期末分享報告）

量化分析中「心態」或「情緒」的前、後測比較雖沒有顯著的改變結果（見表 3），但從學生的行為觀察、訪談、省思報告等質性資料中卻能發現他們的成長型心態、正向心態傾向、幸福感、自我控制、情緒表達、社交化行為，以及整體情緒商數等正持續地成長變化。F7133 的陳述表達出大多數人在修課過程中的心態及情緒變化：

[在課程期間] **保持平常心，心境越來越穩定**；慢慢熟悉 [上課] 之後，發現更可以隨心所欲 [學習]。**到課程尾端，心情不再像開始那般無知的緊張**；很開心，因為當完成學習時，才知道自己沒有想像中的差……**而且覺得自己蠻有學習新事物的能力，更認同自己，也開心「我是做得到的」**……很開心能參加這次的密集課程，**我覺得之前的心態和憂鬱感有了很大的改善**。（F7133，修課學習態度調查）

學生表達「平常心、心境越來越穩定、熟悉、隨心所欲、緊張消失、開心、認同自我、自信、身心平衡」等現象，呈現出他們感受到心態及情緒正隨活動時間的進程逐漸地朝正向變化（R 省思札記 17）。量化分析中「心態」或「情緒」的前、後測比較雖沒有顯著的改變（見表 3），這可能是因活動時間仍不夠長、人數較少所造成的現象，此符合前述 Schwartz 與 Belknap（2017）的論點；但是質性資料分析卻佐證了 Salzman 等人（2019）的觀點：冒險教育能激發參與者成長型心態與情緒商數的效果。

三、研究問題三：學生對教學方式的學習反應

（一）量化資料

學生對 DOL 教學方式的反應，包括對密集式上課接受度、好玩性、挑戰性、學習投入度、認真做作業及個人改變等（range 自 1 ～ 10 分）分析如下（其中第（1）～第（4）之數據參見表 4，第（5）之數據則未列於表 4 中）：

（1）從前、後測「平均數」觀之，學生對 DOL 教學方式或其學習表現，都傾向「10 分」的正向感受（平均數大於 8）；其中個人改變之平均數差距最大。

（2）從前、後測之「相關分析」發現，上課學習投入感受及個人改變等二項無顯著相關，但「密集式上課、學習好玩、具挑戰性、課堂作業認真」等反應的前測、後測分數間都呈現顯著的正相關。

（3）學生修完 DOL 後，在「個人改變、學習好玩、及密集式上課」的正面變化反應最為明顯，Paired *t* 檢驗均達顯著水準。「個人改變」的平均數差距最大，是學生最強烈的課後學習感受，他們也認為 DOL 課程的教與學超乎想像的「學習好玩」，且肯定「密集上課」的方式同樣能產生很好的學習效果。

（4）由後測「平均數」觀之，學習好玩性居首，其後為：個人改變、有挑戰性、學習投入、密集式上課及作業認真，其平均數皆在 9.0 以上。整體而言，他們對自己學習成效的感受已接近「十分」的滿意程度。

（5）前測時，僅學習好玩性與接受密集式上課有正相關性（$r = .88, p < .001$）；但後測時，學習好玩性分別與接受密集式上課（$r = .68, p < .01$）、投入學習（$r = .55, p < .05$）及認真做作業（$r = .68, p < .01$）間呈現顯著的正相關。此顯現「好玩」是密集式課程學習中促進學習參與級表現的一項很重要因素。

表 4

學生修習 DOL 密集課程教學的前、後測感受分析結果

題項	前測		後測		Paired-*t* 值	前測 - 後測平均差	前測 - 後測 Pearson's *r*
	X (*SD*)	range	X (*SD*)	range			
密集學習	8.36(1.55)	6-10	9.07(1.38)	5-10	-2.34*	-0.71	.70**
好玩	8.71(1.32)	6-10	9.50(.94)	7-10	-3.01**	-0.78	.68**
挑戰	9.07(1.07)	7-10	9.29(.91)	8-10	-.82	-0.21	.53*
學習投入	9.07(.92)	8-10	9.21(.97)	7-10	-.52	-0.14	.41
作業認真	8.86(.95)	7-10	9.00(.96)	7-10	-1.00	-0.14	.84***
改變	8.14(1.16)	6-10	9.29(.91)	7-10	-3.89**	-1.14	.46

註：反應等第：從「極負面」(1) 到「極正面」(10)，10 個分數。

n=14 *$p < .05$. **$p < .01$. ***$p < .001$.

（二）質性資料

量化分析發現：整個學習過程中，學生要能感受到「好玩」最為重要，它證實 Mardell et al.（2023）在長期研究中所發展的「好玩的學習」（playful learning）教學理念：Play 是引發及持續參與學習的重要因素之一。好玩的學習中需有「挑戰的」要素，少了它可能會使「好玩」變得無趣、也不容易產生有效的學習效果；學生能克服挑戰，便能累積一點點的「自信」，同時悄悄地浮現出「改變」，並自願地反應在「學習投入」及「認真做作業」的功課上（R 省思札記 17）。

幾乎所有的學生一致認為 DOL 是好玩的課程，從「簡介課程、招募學生」活動→「報名、面談」甄選適合者→「開始暑期密集式」上課→「學習 STEAM 理論及實務」→「颱風攪局」→「調整計畫、克服難阻」，最後「完成課程、達成目標」。每個階段，都有不同的因應活動、目的與驚奇。在課程結束時，讓學生有「如夢醒一般、不可思議、學習收穫滿滿」的感受（R 省思札記 18；F5032 期末分享報告；M7911 期末分享報告；F7171 修課學習態度調查）。M8115、F7116 及 M0004 回憶從被錄取修課到課程結束的故事：

滿心期待地去準備這門課，想像可以有好多時間探索海底世界，拍美麗的照片和家人朋友分享……**心情是「想玩加上學習」……但想「開心玩」的那份比例應該比較大**。課程結束後的心情感覺就是收穫滿滿、好累和遺憾。**[DOL] 真的好玩，它讓我學到很多**，但密集學習確實有許多挑戰……遺憾的是……颱風天導致行程縮減，否則最後產出 [作業] 結果還能更好。（M8115 期末分享報告）

收到被選上的通知，心情非常開心又期待……到開課前一周，開始有點猶豫，有些捨不得要犧牲和家人相伴的時間……第一天課程，我從感到陌生、害怕、到開始期待每天的課程，……**整個課程給我是好玩的心情**：期待→興奮→恐懼→挫折→安全→收穫，我看到自己的進步和成就感……「大海的美」是另一個世界，不同顏色的珊瑚、魚、海龜……這些有趣的景象吸引我越來越喜歡潛水……**課程結束後，我還是會繼續學習潛水的技術**。（F7116 期末分享報告）

這次課程真的收穫滿滿，用影片記錄這 18 天的學習成果是最好的結尾。看著照片、影片……不敢相信一眨眼就過去了。因為颱風……也讓我帶著一點遺憾結束這門課程……經由理論與實踐我慢慢熟悉潛水，從泳池、活水湖、再到綠島海域中……**每個過程都是一項新的挑戰……水下攝影結合潛水技能與攝影技巧，既好玩有趣又富有挑戰性……18 天的課程真的好玩、有趣，也給我很多體悟**：首先，我理解到踏出第一步之後……會比想像得到的多，與其等待，不如主動追求……其次，體會到氣體膨脹、壓力的改變，才領悟到大自然是一本很棒的教科書……第三，密集課程讓我跳脫了 50 分鐘一堂課的框架，密集式學習讓我更享受其中……**經由這門課程洗禮後，我發現學習的思考及行為已有明顯地改變**。（M0004 期末分享報告）

在學生的期末分享報告或修課學習態度調查中，均見到許多類似上述的內容。質性陳述除佐證學生在量化資料中給予將近十分的正向感受外，也說明他們何以對 DOL 課程有高度評價感受的理由。總結學生對 DOL 的學習感受：「個人改變」最為明顯，「好玩」是教學的關鍵因素，接納「密集式學習」是獲得學習成效的根本。「有挑戰性、學習投入及認真做作業」等感受雖沒有顯著改變，但因整個課程設計「好玩」的緣故，它們原本在課前就有充分的心理準備（前測分數均在 8.86 以上），而後自然地表現在學習活動中，即使課程結束後，學生仍自覺這三項都有進步的表現（後測分數 > 前測），這是一般大多數課程在高分程度範圍時不容易做到的教學品質。

四、研究問題四：STEAM 融入戶外冒險學習的教學反思

（一）課程設計

DOL 是以學生學會潛水知識和技能、認識保護海洋環境生態及在地文史為目的。跨領域教學中，學生修課的需求是優先學會潛水，而學習親近海洋生態、環境保護與綠島文史則在輔助潛水的學習與訓練。據此，教師設計密集課程時，必須重視學習內容的優先順序及學習效果，根據專業知識與經驗拿捏教材和活動的輕重，才能使密集課程發揮最大的價值（R 省思札記 2）。DOL 活動期間曾遭遇二次颱風干擾，除緊壓教與學的時間外，也使原本戶外行程計畫要做動態調整，因此教師取捨和調整整體教學活動與內容的專業能力更顯重要。這部分，協同教師從突發的颱風事件中獲得了很好的操練機會和經驗，維繫了學生應有的學習品質與效果（W 師訪談 16）[4]。

有研究指出初階潛水技能採密集式學習和在海洋中操練，學生就能達到最佳的學習效果（Porter & Shucksmith, 2015）。商用潛水課程中多採用短時間密集式教練，使消費者快速學到初階的潛水技能。正規教育中，密集式教學潛水的效果也確實比傳統學期制（每周 2 ～ 3 學習小時）要佳，主要原因是：學期制潛水教學方式，學生在課後固定練習的規律較差，使用潛水裝備及地點也有限制，單靠每周定時定點的上課練習，最後的學習效果較難達到預期目標，學生也較無成就感及收穫感（W 師訪談 15）。從 DOL 的質、量化資料分析中發現，學生密集式學習加海洋實地操練也有不錯的學習效果，支持了正規教育系統中的潛水教學也適合運用 Porter 與 Shucksmith（2015）的密集式教學觀點。

潛水課程融入跨領域知識的教學設計，學生除了能容易地熟練潛水的知識和技能外，還能經由學習其他學科領域的知識和技能，再回饋增益到潛水學習的投入效果（W 師訪談 15）。因此，DOL 融入 STEAM，例如涵蓋海洋環境及生態的科學知識、潛水區在地文化體驗等相關的多元學習，使 DOL 課程不僅變為更有趣，而且也提供學生更多發揮創意的學習機會。

STEAM 在 DOL 中有許多增進學習的效果，尤其「藝術」使得學生對枯燥乏味的反覆練習潛水技術，生澀難懂的海洋生態科學、與潛水有關的科技工程或數學，都變得易懂和樂意接受（R 省思札記 10）。Sousa 與 Pilecki（2018）指出「藝術」對學習理工學科知識具有重要的影響性：藝術能激發好奇心、準確觀察、感知

[4] 質性資料代碼。「W 師訪談 16」代表「第 16 次與 W 師訪談紀錄」，其後表示皆同。

不同形式的物體、表達個人作品、與他人有效合作及進行空間思考；此外，藝術還能改善記憶與認知、促進創造力、增進社交能力、帶來新奇、及減少壓力。在教學中，藝術更能促使學習 STEM（乏味的理工科目）變為有趣。從創意、表現與情緒的角度，藝術與 Play 在很多層面上是互為表裡的活動（Malchiodi & Crenshaw, 2014）。DOL 課程設計中運用創意教學、CPE 策略融入 STEAM 的教學實踐，也使學生在學習與潛水、海洋生態、地方文化等跨領域學科知識時，重新活化他們接受學習「理工科學知識」的熱情、理解、自信和「學即致用」的成長型心態；而 Sousa 與 Pilecki（2018, p. 41）宣稱「學習 STEAM 具有促進成長型心態的效果」也在 DOL 課程得到驗證及支持。DOL 結束後，作者回顧課程設計與實施得到二點啟示：

（1）STEAM 因橫向連結不同學科間相關知識，不僅擴大學習的視野及思考，而且能即時學習與理解不同學科知識間的關聯性，因此更容易吸引學生的學習興趣，甚者可能發展出鑽研其中某一專門學科的興趣。

（2）要達到前述目的，教師具備「跨領域教學素養及能力」至為重要。他（她）要具有設計跨領域知識架構的課程能力，並能組成該門課程的跨領域教師團隊，或者能單獨執行該門跨領域課程的教學能力。具有跨領域課程之知識理論及累積實踐經驗，才是實施跨領域教學成功的重要關鍵。

（二）教學成效

評估教學來自二個層面：學生的學習及教師的教學。從教師觀察學生的學習成效：綜合評價達到八成五的學習效果，所有學生都順利取得「開放水域潛水員證照」（Open Water Diver），其中，三成左右的學生在課程結束後仍自行到綠島做潛水活動（W 師訪談 20）。學生們則表示在 DOL 中的各方面學習表現都是將近十分滿意或收穫的結果，其中八成學生未來願意再選修類似的課程，約二成的學生提出在滿足某些條件下，願意再嘗試選修類似課程。Blazar 與 Kraft（2017）指出學習表現、心態及行為可作為衡量學生學習成效的指標，而教師的教學效果則受到專業知識、教學策略與技巧、教學態度等因素的影響。從學生的質、量化資料分析發現，他們在 DOL 的戶外冒險活動中學習 STEAM 的學科知識、心態、情緒或行為等部分，皆呈現好的結果。此種質、量化資料混合的評估方法也吻合了 Gilbertson 等人（2022）認為「採多元證據才能客觀評量出戶外教育學習成效」的觀點。而學生的學習成效，主要仍受惠於教師的創意教學哲思、技巧及策略。

DOL 中，採用「選擇、玩、練習」的 CPE 策略進行教學。教師利用「對話」

方式給予學生有「選擇的」學習權利，例如透過「對話」讓學生思考如何選擇修習「密集課程」、上課內容、作業形式等，並在密集教學中運用 Mosston 與 Ashworth（2008）使用之「價值陳述」與「糾正陳述」二種回饋技術與學生互動，達到支持與增強學生的熱情、動機及行動力的學習效果。教師善用了選擇理論中強調「對話」的論點，積極回饋學生的反應，運用 Burnage（2018）的「創意學習」竅門引導學生，使他們能做出最符合個人需求與期望的選擇決定，並且達到教師的教學目的。

再者，DOL 的核心之本是「玩」（Play），支持了 Singer 等人（2006）所提 play=learning 的觀點。學生來修習 DOL 密集課程，主要是基於「課程好玩」（W 師訪談 6，7，12，20），因為好玩及好（ㄏㄠˇ）玩，才願意投入學習而得到意想不到的成就感，特別是突破自我的限制所產生的個人改變。教師採「playful learning」教學設計，運用「自由玩→認真玩→有目的的玩」的 3P 策略，讓學生持續覺得「好玩的學習」，才可能維持他們在學習中的趣味、熱情投入、自信、熟練、自主學習及個人改變。這項教學思維與策略正吻合 Harvard University 教育研究院在 Project Zero 實驗方案中發展 Playful Learning 的三項指標（Mardell et al., 2023）：（1）發現趣味（finding joy）：在「自由玩」中；（2）探索未知（exploring the unknown）：在「認真玩」中；（3）主導學習（leading learning）：在「有目的的玩」中。因學生持續保持「好玩的」心態及情緒，使他們在短時間高強度的密集學習環境中能有不錯的學習效果（R 省思札記 18）。

「練習」（Exercise）是培養「熟練」的基本功。在練習策略中，教師採用「重複→重複→更新」及「模仿——熟練——創新」的教學技巧（陳嘉彌、陳淑芳，2021），無論是學習有關潛水、海洋生態或地方文史的知識和技能，都強調現場的「反覆、更新」學習，如「泳池→活水湖→綠島海域」即運用「重複→重複→更新」及「模仿——熟練」來強化學生在水中的浮潛動作、信心與適應情境，同時搭配「助教帶新手」的潛伴制度，讓學生能獲得充分的安全感。這些做法既提升學習成效，相對地也減少了教學的風險壓力（W 師訪談 6）。同樣地，學習海底生態、環境議題、水中攝影與數位影像製作等也是透過類似上述方式獲得成果。

在 CPE 中，再加入「連結→連結→擴展→連結」STEAM 的技巧，能讓學生容易地融會貫通跨領域的知識與應用。DOL 能統整學習 STEAM 的成效很大部分是來自於「戶外冒險學習——潛水」的貢獻，這吻合 Munge 等人（2018）的論述：高等教育中使用戶外體驗式學習進行跨領域知識教學，能增加學生參與學習、擴展知能及專業能力；雖然可能因「風險因素」而無法製定「標準化教學」的弱點，但

相對地師生卻能在教學中增加更多應變、挑戰與合作的機會，促使學生能更深入體驗探索、合作、及學習如何學習的方法，而得到更多「連結→擴展」的學習收穫。

（三）風險影響

「風險」本身就具有學習的價值，但應在維護教學安全的可預期和可控範圍內發揮其最大價值（W 師訪談 2）。儘管規劃暑期課程時已將「颱風」列入預期風險，以避免教學困擾（如學生擔心取消綠島潛水活動、害怕都在教室內學習等），但期間二次颱風（超過預期概率）還是影響 W 師的原本課程規劃及行程，並造成其他合作教師困擾及學生影響學習情緒等問題。W 師熟稔戶外風險管理與應變處理，除在官方宣布颱風停課時改為「線上授課」外，也在「復課」後立即調整授課內容的優先順序，並利用在綠島活動的晚上時間補充颱風期間線上授課的內容。「密集式課程」的教師必須能即時擇定所有「教與學」的重點、調整及取捨內容的優先順序，才可能在「突變的」教學情境中維持原有的課程目標及教學目的（R 省思札記 15）。

因颱風影響原有教學計畫，不得不調整甚至捨棄部分學習內容，這可能給協同教師和學生帶來心理壓力，特別是來自學生的負面情緒，可能降低整體的學習效果。在緊迫的教學時間裡，教師可以表現出對「學生學習新知識 / 技能會有壓力」的同理心，屏除個人本位的意識，調整協同教師的原有角色和工作內容，這都以減緩學生的負面心理風險。在這種情況下，通過「重複→重複」及「模仿——熟練」的教學技巧可以幫助學生從溫故知新的複習中建立學習信心，為未來的「更新」和「創新」學習做好堅實的準備。

伍、啟示

綜合文獻概述、質性及量化資料分析與討論，提出四點啟示：

一、戶外冒險學習的密集式課程（intensive course）既具教學吸引力，也能有實質的教學成效。它將是未來高等教育發展課程模式及創意教學的重要趨勢之一。

二、戶外冒險活動融入 STEAM 跨領域知識是具有教學成效的創意教學策略。它不僅能快速引導學生進入教學情境，學習及統整不同學科的新知識，而且學生也能從中發現自己須再加強的能力，或有興趣鑽研的專業科目。

三、因研究樣本數少，量化資料分析結果雖未能充分支持「戶外冒險密集式學習活

動能促進學生心態及情緒發展」的論點，但質性資料分析則豐富呈現學生正面心態及情緒的經驗證據（empirical evidence），這是在小樣本中發現實質影響學習成效的重要關鍵。教師如期待在量化分析數據呈現推論性的結果，未來的課程設計可考慮延長活動時程、增加參與樣本數，或增加類似課程次數，再做量化研究調查時，很可能獲得顯著的統計結果。

四、教師在實踐戶外冒險學習融入跨領域知識的創意教學時，應重視「跨領域課程與素養」的自我專業成長，俾利應變教學現場的不確定風險因素、提升跨領域教學的專業績效，以增大學生的學習效益。對戶外教育者而言，更應如此。

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An Analytical Study on Establishing Norms for Creativity among Pre-service TCSOL Teacher Education Students in Taiwan

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Abstract

This study aimed to establish creativity norms for pre-service Teaching Chinese to Speakers of Other Languages (TCSOL) teacher education students (PTTES) in Taiwan and to analyze their differences in creativity. Utilizing the New Creativity Test, which was validated for reliability and validity, this study sampled and tested 414 Taiwanese PTTES. The findings reveal that: (1) the figural creativity-elaboration of PTTES is slightly higher than that of Taiwanese undergraduates and postgraduates, while other aspects of creativity in PTTES are slightly lower; (2) there were no significant differences in creativity between male and female PTTES; and (3) PTTES in postgraduate programs significantly outperformed undergraduate PTTES in verbal creativity-fluency, while PTTES in both postgraduate and credit programs significantly exceeded those in undergraduate programs in verbal creativity-originality. Furthermore, PTTES in credit programs demonstrated significantly higher figural creativity-originality than those in postgraduate programs. Based on these results, this study proposes the CREATIVE Flower Model as a creativity pedagogical framework for TCSOL programs in Taiwan, offering targeted teaching strategies for each group. For postgraduate PTTES, the "Challenging" strategy can urge them to undertake tasks that demand higher levels of critical thinking and problem-solving in a linguistically rich environment. The "Adaptive Solutions," developing innovative responses to these challenges, will likely be the most impactful for enhancing figural creativity-originality in postgraduate PTTES. Undergraduate PTTES can benefit from the "Team Presentation," sharing and showcasing creative ideas and solutions, and "Impact Evaluation," which measures the effectiveness and practicality of the proposed solutions to build creative confidence and communication skills. Credit program PTTES, who excels in figural creativity-originality, can be tasked with interdisciplinary projects that integrate TCSOL concepts to develop innovative teaching methods and materials. Leveraging the CREATIVE Flower Model enhances the creativity of PTTES and addresses potential challenges in Chinese language classrooms, ultimately contributing to the development of effective and innovative TCSOL teachers.

Keywords: creativity norms, Teaching Chinese to Speakers of Other Languages (TCSOL), pre-service TCSOL teacher education students (PTTES), creativity pedagogy

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臺灣華語教學師資生創造力常模建立之分析研究

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摘 要

本研究旨在為臺灣華語教學師資生建立創造力常模，分析其創造力的異同。本研究以經信效度驗證過的新編創造思考測驗為研究工具，抽樣調查 414 名臺灣華語教學師資生並進行施測。研究發現：（1）華語教學師資生在圖形的精進性創造力略高於臺灣的大學生和研究生，但其他創造力表現則略低；（2）男、女華語教學師資生的創造力無顯著差異；（3）研究所的華語教學師資生在語文的流暢性創造力表現顯著高於大學部的華語教學師資生，而研究所和學分學程的華語教學師資生在語文的原創性創造力表現顯著優於大學部的華語教學師資生。此外，學分學程的華語教學師資生在圖形的原創性創造力表現顯著高於研究所的華語教學師資生。本研究根據結果，提出創意花模式作為在臺華語教學系所和學分學程課之創造力教學架構，針對華語教學師資生提供教學策略。對研究所的華語教學師資生來說，「挑戰性」策略能促使其在語言豐富的環境中以更高層次批判性思維來思考與執行解決問題的任務。發展創新應對方法的「適性解決之道」是提升研究所華語教學師資生圖形原創性創造力之有效策略。大學部的華語教學師資生則可以從分享及展現創意想法和問題的「小組演示」中獲益，以及從檢測解決方法之效用的「影響力評估」中來建立其創意自信與溝通技巧。具圖形原創性創造力優勢之學分學程的華語教學師資生，可以透過跨學科專題方式整合華語教學概念來發展創新的教材教法。借助創意花模式來提高華語教學師資生的創造力並因應華語課堂中的潛在課題，將有益於培養其成為具創新能力的華語教師。

關鍵詞：創造力常模、華語教學、華語教學師資生、創造力教學

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I. Introduction

The growing recognition of the importance of creativity in language teaching (Richards & Cotterall, 2016) has significantly impacted the field of Teaching Chinese to Speakers of Other Languages (TCSOL). Research consistently shows that fostering creativity enhances student motivation and engagement, facilitates more profound learning, and improves language acquisition (Maley & Peachey, 2015). This emphasis aligns with global trends in language education, evidenced by initiatives such as the "A Show of Creative Chinese Language Teaching: A Competition of Sharing Teaching Modes" organized by the Overseas Community Affairs Council, Republic of China (Taiwan) in 2011, and the advocacy by the Taiwan Ministry of Education (2023) for innovative Chinese teaching methods, exemplify this growing focus (Becker & Roos, 2016; Maley & Peachey, 2015; Richards, 2013).

Modern colleges and universities increasingly prioritize developing students' creativity (Zhao & Zhao, 2012). TCSOL educators understand that engaging classroom activities and routines offer prime opportunities to nurture student creativity. However, a comprehensive search using Boolean Logic across major academic databases—including Taiwan's online Airiti Library, ERICDATA, National Digital Library of Theses and Dissertations in Taiwan, China Academic Journals Full-text Database, China Masters' Theses Full-text Database, China Dissertations Database, EBSCOhost, ProQuest, and ERIC - Education Resources Information Center—reveals a scarcity of research on creativity within TCSOL education. Exceptions include Yang (2001), who discussed creative teaching methods at a Chinese language school in Boston, and Moloney and Xu (2016), as well as Lu (2017), who highlighted the effectiveness of creative approaches in Chinese as a Foreign Language (CFL) programs. Professor Yea-Fen Chen, director of the Chinese Flagship Center at Indiana University Bloomington, in an exclusive interview, pointed out several challenges faced by Taiwanese TCSOL educators, such as rigid teaching methods and a lack of engagement and professional knowledge in educational psychology (Li, 2012). Lee et al. (2010) argued that enhancing student creativity in task-solving in Chinese teaching relies not solely on the teacher's creativity but also on the systematic creation of learning environments that encourage novel approaches and

critical thinking. Zhong (2022) found improvements in college students' Chinese language and literature scores following creative thinking teaching, alongside reduced reading anxiety among students in the experimental group compared to the control group.

Given the limited literature on creative approaches within TCSOL, this study investigates the creativity of students enrolled in TCSOL postgraduate, undergraduate, and credit programs[1] in Taiwan, defined herein as pre-service TCSOL teacher education students (PTTES). According to the objectives of this study, the research questions to be addressed are as follows: (1) What are the creativity norms for PTTES? (2) What possible differences in creativity exist between male and female PTTES? and (3) What possible differences in creativity exist among PTTES in various TCSOL programs? The results of this study have implications for future research and practice of TCSOL for contributing to the development of future educators by equipping them with the ability to employ innovative and effective pedagogical strategies in their classrooms.

II. Literature Review

A. Creativity and Instruments

Guilford (1967) posited that divergent thinking is an ability that generates a multitude of potential solutions to a problem and is a crucial psychological skill for developing creativity. This skill encompasses fluency, flexibility, originality, and the capacity for elaboration. The Torrance Tests of Creative Thinking (TTCT), devised by Torrance (1966), are categorized into verbal and figural tests, primarily measuring participants' fluency (the number of distinct ideas), flexibility (diversity of thought), originality (uniqueness of ideas), and elaboration (detail enhancement) (Torrance, 1974). Subsequent research on creativity has focused mainly on these four thinking abilities, following Guilford and Torrance's pioneering work in creativity measurement (Kaufman & Sternberg, 2010; Lin, 2000). For example, the Creative and Effective Teaching Assessment (CETA), developed by Aschenbrener et al.(2010), is based on the TTCT and

[1] TCSOL credit programs are designed for non-TCSOL major students who are interested in becoming TCSOL teachers.

includes four dimensions of a teacher's creative teaching behavior—fluency, flexibility, originality, and elaboration—with 16 items in total, and has demonstrated high reliability (Cronbach's α = .97). Amabile (2018) noted that the scoring of creativity tests based on these four abilities varies across studies.

In Taiwan, the TTCT has been widely used and adapted for research. For instance, Liu and Hsu (1974) revised it into the "TTCT A for Chinese Language," and Wu et al. (1992) further adapted it into the "TTCT B for Chinese Language." Similarly, for the "Torrance Figural Tests of Creative Thinking," Wu et al. (1993) developed the "Torrance Figural Creative Thinking Test A," and Chen (1986) introduced the "Torrance Figural Creative Thinking Test B."

The New Creativity Test, devised by Professor Jing-Jyi Wu for Taiwanese students, is a widely recognized tool in Taiwanese academia (Wu et al., 1998). The test is designed to assess fluency, flexibility, originality, and elaboration, comprises verbal and figural parts, and targets a broad range of participants from fifth graders to postgraduates. The verbal section challenges participants to conceive novel and exciting uses for chopsticks beyond their conventional use. In the figural section, participants are asked to perceive the Chinese character " 人 " (person) as a figure rather than a word, incorporating it into a drawing where the character forms part of a larger picture or object. Each part of the test has a completion time limit of 10 minutes.

Within this study, aimed at assessing the creativity of PTTES, creativity is delineated as follows:

Fluency: The production of a multitude of ideas for problem-solving, applicable to both verbal and figural thinking.

Flexibility: The ability to employ various approaches, patterns, or classifications in conceptualizing a problem or situation.

Originality: A measure of innovative uniqueness, reflecting the capacity for novel thought, foresight, and thinking "outside the box."

Elaboration: The skill of refining and expanding upon an original or basic concept to generate new ideas.

B. Current Landscape of Creativity Research in TCSOL

Creativity in language teaching, characterized by a diverse repertoire of strategies and flexibility in approaches (Richards & Cotterall, 2016), benefits students by enhancing academic achievement, fostering meaningful learning (Rinkevich, 2011), and reducing aversion to the subject (Tavakoli et al., 2017). It promotes creative thinking and autonomy among learners (Nosratinia & Zaker, 2014). These pieces of evidence not only illustrate creativity as a facilitator of a virtuous cycle between teachers and students but also align with findings from other studies (Al-Mahrooqi et al., 2015; Bourke & Lidstone, 2015; Cross, 2018; Chen, 2020; Drapeau, 2014; Gómez-Arizaga et al., 2016; Huang & Szente, 2014; Naz & Murad, 2017; Nosratinia & Zaker, 2014; Solihati & Hikmat, 2018).

Although creativity holds significant importance in language teaching worldwide, research specifically focused on TCSOL is relatively scarce compared to other languages like English. In a study conducted by Chen (2008), it was found that 32 TCSOL teachers who were part of an experimental group and underwent training in a creativity and instructional design program exhibited significantly higher levels of creativity in terms of fluency, flexibility, originality, and elaboration than their counterparts in a control group. Cai (2018) utilized exploratory factor analysis on three occasions to categorize Taiwanese student teachers' creative TCSOL practices into eight types: demonstration and listening, collaborative learning, problem-solving, interactive discussion, heuristic thinking, brainstorming, incorporating current news and issues into TCSOL, and student-centered teaching. Dai et al. (2019) argued that linguistic authenticity found in daily life enhances Chinese L2 learners' proficiency, and developing their linguistic creativity expands their applied ability in teaching Chinese grammar. Kuo et al. (2019) discovered that the cooperative learning teaching strategy is most effective for writing creativity, followed by mind mapping and creative teaching methods.

Indeed, creativity is crucial for producing creative works (Vally et al., 2019), and language teachers who demonstrate creativity employ various teaching strategies and techniques, avoiding reliance on a single approach or method (Richards & Cotterall, 2016). However, research on the creativity of PTTES preparing to become in-service TCSOL teachers is limited. This knowledge gap motivates the current study to analyze and establish creativity norms for PTTES in Taiwan.

C. Gender Differences in Creativity Research

The utility of teachers' creativity significantly benefits L2 learners' proficiency (Ševečková, 2016; Suwartono, 2016; Vasudevan, 2013). Despite the rapid proliferation of TCSOL courses globally, few studies have explored the relationship between creativity and gender, program types, and pre-service teachers within the Chinese educational system (Wu, 2017).

Regarding gender differences in creativity, Baer and Kaufman (2008) highlighted the consistent absence of gender disparities in creativity test scores between boys and girls. There is a vast difference in creative achievement between men and women in many fields, which makes blanket environmental explanations inadequate, and the explanations that have been proposed so far are incomplete at best. Abraham (2016) and Ülger & Morsünbül (2016) concurred that, despite substantial scientific and public interest, no definitive conclusions have yet been reached regarding gender differences in creativity.

From a country-specific perspective on pre-service teachers' creativity, Ponnusamy (2019) analyzed 140 pre-service teachers from 10 secondary teacher education colleges in India, finding no significant gender differences in the Passi Creativity Test. This finding aligns with Andrade and Pasia's (2020) observation that there is no gender difference in the mathematical creativity of Filipino pre-service teachers. However, a study involving 206 undergraduates (51.9% female) in Hong Kong, including a divergent thinking test and a creative problem-solving test, revealed that male undergraduates generally showed more significant variance than females in creativity scores for both divergent thinking and creative problem-solving. Notably, greater male variability was more pronounced in figural creativity, with larger effect sizes, than in verbal creativity (He & Wong, 2021). In Turkey, Arikhan and Coban (2021) assessed the creativity of 110 senior students from the Department of Music across three universities, finding gender differences in scores on the Creativity Foster Teacher Index Scale (CFTIS) and the Kaufman Creativity Fields Scale Turkish Form (KCAS-TF).

Although the Amusement Park Theoretical (APT) Model was proposed by Baer and Kaufman (2005) to explain gender differences in creativity (Baer & Kaufman, 2008), a

conclusive stance on this matter remains elusive. It is hoped that the present study will illuminate potential gender differences in creativity among PTTES.

D. The Impact of Educational Program Differences on Creativity

The influence of educational programs on the development of students' creativity, particularly for those enrolled in advanced courses, has sparked considerable debate. Factors such as the years of study and majors of study have been identified as affecting creativity (Cheung et al., 2003; Daly et al., 2016). Naderi et al. (2010) found a high correlation between creativity and academic achievement among Iranian female undergraduates in Malaysian universities but a low correlation for their male counterparts. In exploring pre-service teachers' conceptions of creativity within the English curriculum, researchers discovered that these individuals' understanding of creativity was often limited, frequently blurring the distinction between the concept of creativity and instances of creative examples observed in class (Newton & Beverton, 2012). Topoğlu (2015) utilized the "How Creative Are You?" creativity scale to assess 1,028 pre-service teachers at a Turkish university and concluded that their creativity levels were below average. Interestingly, art pre-service teachers exhibited higher creativity levels than their peers specializing in music, with similar trends observed among class homeroom teachers and those teaching social studies and science. In Brazil, Fleith (2019) interviewed six students and six postgraduate professors from private and public universities, concluding that creativity is essential for graduate education development. However, both groups acknowledged personal and institutional barriers to creativity. Creativity has been a focal point in psychological and educational research for decades, predominantly within elementary and secondary education contexts (Beghetto, 2007; Cachia & Ferrari, 2010; Kupers et al., 2018; Kupers et al., 2019; Subali et al., 2017; Suparmi et al., 2018) and in English as a second/foreign language education (Deshors et al., 2018; Liao et al., 2018). These findings contribute to understanding the relationship between creativity, teaching, and learning.

In Taiwan, the duration of study varies by program focus: undergraduate PTTES typically requires four years and 128 credits for graduation; postgraduate PTTES needs

two to four years and 36 units; and non-TCSOL major students enrolled in TCSOL credit programs require two years and at least 20 credits. The findings from the research above suggest that differences in creativity among PTTES in various programs may arise due to differing study durations. Therefore, the different study durations of TCSOL programs prompt curiosity about how results from studies focusing on the TCSOL context would integrate into the broader picture established by the previously discussed findings. Therefore, this study aims to analyze the creativity of PTTES across different TCSOL programs.

E. The Theories and Research for Fostering Teacher-Student Creativity

A recent literature review on promoting creativity between teachers and students identifies two main approaches. The first involves applying theories such as Social-Cognitive Theory (SCT), Constructivist Learning Theory (CLT), and Experiential Learning Theory (ELT). The second involves implementing frameworks and skills for teaching creativity.

1. Theoretical Applications

SCT, proposed by Bandura in the 1960s, suggests that learning occurs through observation, imitation, and modeling (Bandura, 1986, 2001). Nwosu et al. (2022) implemented Placement Learning in Business Firms (PLBF) based on SCT for 273 university students, validating the SCT perspective by revealing that students undertaking PLBF can develop entrepreneurial creativity. Rubenstein et al. (2018) examined teachers' perceptions of creativity using SCT factors. They found that pre-service teachers expressed more optimism about their future environmental support and lower self-efficacy for developing creative thinking than in-service teachers. Hsiao (2022) applied Bandura's self-efficacy to validate that the creative self-efficacy of 214 elementary teachers significantly influences their creativity teaching.

From a CLT perspective, which emphasizes active engagement and inquiry-based learning, learners are believed to benefit most from interactions and collaboration in solving problems (Zigelman, 2018). Based on constructivism, teachers are encouraged to create stimulating environments that promote students' exploration, reflection, and

integration of new ideas with existing knowledge (Wach, 2018). From interview analyses, Apaydin and Güven (2022) concluded that constructive learning principles such as active participation and collaboration effectively develop pre-service teachers' creativity.

Embracing Dewey's educational philosophies, experiential learning promotes learning by doing and encourages hands-on experiences and active participation. Kolb's ELT underscores the importance of concrete experiences, reflective observation, abstract conceptualization, and active experimentation in learning (Kolb & Kolb, 2012). Helate et al. (2022) found that a positive interlink among variables such as experiential learning activities and strategies enhances the professional development of language teachers. Calavia et al. (2021) introduced the "Think-Create-Learn" (TCL) methodology, incorporating elements of experiential learning to provide an active environment for developing students' creativity and critical thinking.

2. Creativity Teaching Frameworks and Skills

Creative thinking is a crucial dimension of creativity, along with fluency, flexibility, originality, and elaboration (Amabile, 2013; Aggarwal et al., 2017; Carayannis, 2020; Torrance, 2018). Lavi and Marti (2023) proposed a case-based learning pedagogical framework that uses student-centered and teacher-guided scaffolding to facilitate creative thinking. Based on Rhodes's (1961) 4P model of creativity, the 5 A's framework—actor, action, artifact, audience, and affordances—aims to stimulate creativity in the classroom (Glăveanu, 2013; Zhang et al., 2023). Ritter et al. (2020) designed a creativity training program where students learn to apply a six-step cycle of creativity to various problems. Zhong (2022) validated that a scaffolding teaching model based on creative thinking can improve students' interest in Chinese reading and reading levels.

Integrating art into TCSOL education allows PTTES to develop picture books through dialogue for creative thinking and brainstorming (Cai, 2017). A meta-analysis by Kuo et al. (2019) showed that cooperative learning, mind maps, and creative-thinking instruction significantly impact creativity dimensions such as fluency, flexibility, and originality. Yang (2022) argued that incorporating poetry creation into Chinese language classes enhances comprehension, engagement, and a passion for learning among Chinese L2 learners.

The literature broadly supports guiding students to identify real-world issues and

collaborate to solve problems, reflecting and receiving feedback as critical elements for developing creativity. Creativity is considered a crucial 21st-century thinking skill in university teaching and learning (Ahmadi et al., 2019; Nakano & Wechsler, 2018; Calavia et al., 2021; Saroyan, 2022). Challenges remain in defining PTTES' creativity and identifying potential creativity teaching models for TCSOL programs in contexts where creativity is a valued aspect of higher education. According to Heacox (2017) and Tomlinson (2017), tailored educational strategies to accommodate diverse learning characteristics and maximize student potential are essential. Recent studies show differences in attributes between undergraduates and postgraduates. For example, undergraduates are more influenced by socioeconomic background, parental education, and structured support systems, relying heavily on financial aid and academic resources (Office for Students, 2020). In contrast, postgraduates benefit from institutional support, high-quality supervision, and personal attributes like self-efficacy and motivation, often engaging in complex, independent research projects requiring advanced research skills (Hadi & Muhammad, 2019; Mudzi & Sepeng, 2023; The Open University, 2021). Despite little related literature existing (Hlas & Hlas, 2024), this study argues that differentiated and creative instruction is crucial to address the potential differences in creativity among PTTES in TCSOL programs, and according to my teaching experience, assumes that undergraduate PTTES may benefit from structured activities that build foundational creative skills, such as collaborative projects and peer review sessions that encourage the generation of diverse ideas and solutions, postgraduate PTTES can be challenged with complex, real-world problem-solving tasks that require advanced critical thinking and reflective discussions to deepen their creative processes, and non-TCSOL major students in credit programs can be engaged in interdisciplinary projects that integrate their diverse academic backgrounds with TCSOL concepts, fostering innovative teaching materials and methods. Therefore, this study seeks to fill the knowledge gap by employing a quantitative approach to explore creativity among PTTES in TCSOL programs, proposing an instructional model to inspire creativity based on the findings. By doing so, this study not only contributes to the existing literature but also offers practical insights for developing creative pedagogical strategies tailored to PTTES' creativity at different educational levels.

III. Research Method

A survey method was utilized to establish the creativity norms for PTTES. This method is favored in social sciences for its efficiency, cost-effectiveness, and ability to collect data (Fowler, 2013). When investigating human minds and behaviors, the challenge often lies in the target population being too vast for direct individual study. Extensive sample surveys facilitate the detection of subtle effects even when analyzing multiple variables and, depending on the survey design, enable comparative analysis of population subgroups (Bhattacherjee, 2012). Variable analysis requires a sufficiently large sample size to address the research questions and achieve the study's objectives. Although no research method is without its limitations (Queirós et al., 2017), the survey method offers the most comprehensive and accurate information for this study. This section outlines the research instrument, participants and sampling, and data processing and analysis:

A. The Research Instrument

The New Creativity Test, discussed in the Literature Review, was chosen for this study for four reasons:

1. Considering the characteristics of the participants and the frequent use of pictures and words in TCSOL classes, the New Creativity Test, appropriate for adults, was selected to measure the creativity of PTTES.
2. Many Taiwanese assessment tools are adaptations of foreign assessments, which may not always account for the diverse cultural backgrounds of Taiwanese individuals. The New Creativity Test was explicitly developed to address this issue among Taiwanese participants.
3. The test, a modification of the TTCT tailored for Chinese learners, has demonstrated excellent reliability and validity (Wu et al., 1998).
4. This study aims to establish creativity norms for PTTES and compare their creativity levels with those of university students in a study by Wu et al. (1998). Accordingly, the New Creativity Test was adopted, with modifications to include demographic information (Appendix 1[2]) relevant to this study.

[2] This study was administered using the Chinese-only version.

Applying the New Creativity Test in this study revealed Cronbach's α of .856 for verbal creativity and .776 for figural creativity. The factor loadings for fluency, flexibility, and originality in verbal creativity were .919, .874, and .799, respectively, while those for fluency, flexibility, originality, and elaboration in figural creativity were .870, .860, .847, and .443, respectively. These metrics affirm the test's reliability and validity in this study.

B. Participants and Sampling

Participants selected for this study were students enrolled in TCSOL programs across Taiwan. Pre-service TCSOL teacher education courses are offered through TCSOL departments, postgraduate programs, and credit programs. They are designed to provide individuals with the necessary skills to become TCSOL teachers, referred to as PTTES in this study. The target population and sampling process used in the study are described in detail below:

According to the Department of Statistics, Ministry of Education (2023), 19 universities in Taiwan have TCSOL departments. The distribution of students across TCSOL bachelor's, master's, and doctoral programs comprises 2,330 (73.0%), 771 (24.2%), and 91 (2.8%) students, respectively. The New Creativity Test, utilized in this study, presents challenges for online administration due to stringent time constraints and the requirement for participants to complete figural creativity tasks with drawings. Therefore, in-person class time was borrowed from instructors and students for test administration. Purposive sampling led to administering 561 tests after obtaining consent from instructors and students via telephone and email across Taiwanese TCSOL programs for undergraduates, postgraduates, and non-TCSOL major students enrolled in credit programs. Ultimately, 435 tests were collected in person, resulting in an overall response rate of 77.54%. Hair Jr. et al. (2020) identify tests as invalid when participants do not respond, provide irrelevant responses, or when more than 15% of responses are missing. Given that the New Creativity Test allocated ten minutes each for verbal and figural creativity, 21 late participants could not complete the test within the allotted time, resulting in their exclusion. Consequently, 414 valid tests remained, yielding an effective response rate of 73.79%. Detailed demographic information on the participants is presented in Table 1.

Table 1

Demographic Information About Participants

Category	Level	Number	Percentage
Gender	Female	364	87.92%
	Male	49	11.84%
	Unreported	1	0.24%
Age[3]	18-22	311	75.12%
	23-49	95	22.95%
	Unreported	8	1.93%
Programs	Undergraduates	239	57.73%
	Postgraduates	77	18.60%
	Non-TCSOL Major Students in Credit Programs	98	23.67%
Taking Courses at a Teacher Education Center	Yes (courses completed)	29	7.00%
	Yes (taking courses)	111	26.81%
	No	274	66.19%
TCSOL Certificate	Yes	15	3.62%
	No	399	96.38%
TCSOL Internship Experience	Yes	156	37.68%
	No	258	62.32%
TCSOL Practical (Full-/ Part-Time) Experience	Yes	60	14.49%
	No	354	85.51%

The participants in this study comprised 364 females (87.92%), 49 males (11.84%), and one unreported (0.24%). This gender distribution is consistent with the gender imbalance observed in TCSOL programs, where females constitute around 80% of the population and males only around 20%, according to statistical data reported by the Department of Statistics, Ministry of Education in 2023. Despite this skew, the study's results are still valid and statistically significant, as indicated by the normality test (Kolmogorov-Smirnov = .034, $p = .20 > .05$), which suggests that participants' responses to creativity questions fit a normal distribution. This finding aligns with the guidelines outlined by Blackford (2017) for ensuring the robustness of statistical results despite demographic disparities within the sample population.

[3] The age of participants ranged from 18 to 49, with the maximum age being 49.

This study analyzed the TCSOL internship experience of 156 participants using Cross-tabulation analysis. The results revealed that 86 (55.13%) of the participants were undergraduates, 46 (29.49%) were postgraduates, and 24 (15.38%) were non-TCSOL major students enrolled in credit programs. Of the 77 postgraduates, 46 (59.74%) reported having TCSOL internship experience. Similarly, 86 (35.98%) out of 239 undergraduates and 24 (24.49%) out of 98 non-TCSOL major students also reported having TCSOL internship experience.

Regarding practical TCSOL experience, 33 (55.00%) of 60 were postgraduates, 16 (26.66%) were undergraduates, and 11 (18.34%) were non-TCSOL major students in credit programs. However, out of the total participants, only 33 (42.86%) of 77 postgraduates, 16 (6.69%) of 239 undergraduates, and 11 (11.22%) of 98 non-TCSOL major students reported having practical TCSOL experience.

The study employed a purposive sampling strategy to ensure a comprehensive understanding of creativity among a representative group of PTTES across Taiwan. The in-person test administration further strengthened the study's methodological rigor.

C. Data Processing and Analysis

This investigation utilized several statistical techniques to analyze data pertinent to the study's objectives and research questions. Initially, descriptive statistics, including *T* scores and *PR* (Percentile Rank) values, were employed to establish the creativity norms for PTTES. This process follows the methodology proposed by Kaplan and Saccuzzo (2017), comprising the main steps for norm construction: (1) calculating the mean of the raw scores, (2) determining the standard deviation of the raw scores, (3) converting raw scores toj84scores, and (4) transforming *T* scores into percentiles.

Subsequently, independent-sample *t*-tests were conducted between male and female PTTES to explore potential gender differences in creativity. This step aims to identify any significant disparities in creativity based on gender within the cohort.

Finally, to examine the possible differences in creativity among PTTES across various TCSOL programs, a one-way multivariate analysis of variance (MANOVA) was applied. This analysis specifically focuses on assessing the impact of different program types on PTTES' creativity, providing insights into how educational context influences creative output.

IV. Results

A. The Establishment of Creativity Norms for PTTES

Since the original score of the test can only be used to compare the differences in the intrinsic traits of the participants, it is not appropriate to prove the relationship between the participants and the reference group. This study, therefore, established the verbal (Appendices 2-5) and figural (Appendices 6-10) creativity norms for PTTES based on *T* scores and *PR* values. The norms showed the participants' relative position in the reference group and could provide valuable data for future research and practice.

Based on the constructed creativity norm (Table 2), this study found that approximately 20.05% of PTTES possess strong verbal creativity ($T \geqq 170$), while around 31.88% exhibit weak ability in verbal creativity ($T \leqq 134$), and about 48.07% demonstrate relatively normal ability in verbal creativity ($170 > T > 134$). The mean value of verbal creativity for PTTES is 149.15, lower than that of Taiwanese undergraduates and postgraduates ($T = 156$, $N = 516$) (Wu et al., 1998).

Table 2
T *Scores and* PR *Values for Verbal Creativity among PTTES*

T Score Range	*PR* Value Range	*M*	*N*	%
170 and above	75 to 99	149.15	83	20.05
Between 134 and 170	26 to 74		199	48.07
Below 134	1 to 25		132	31.88

Note: "M" represents the mean value of verbal creativity, "N" represents the sample size, "CN" represents the cumulative number, and "%" represents the percentage in Tables 2 to 10.

Table 3 presents that around 25.12% of PTTES show strong ability in verbal creativity-fluency ($T \geqq 57$), approximately 30.43% exhibit weak ability in verbal creativity-fluency ($T \leqq 42$), and about 44.44% demonstrate a relatively normal ability in verbal creativity-fluency ($57 > T > 42$). The mean value of verbal creativity-fluency for PTTES is 49.37, slightly lower than that of Taiwanese undergraduates and postgraduates ($T = 52$, $N = 516$) (Wu et al., 1998).

Table 3
T *Scores and* PR *Values for Verbal Creativity-Fluency among PTTES*

T Score Range	*PR* Value Range	*M*	*N*	%
57 and above	77 to 99	49.37	104	25.12
Between 42 and 57	34 to 72		184	44.44
Below 42	1 to 27		126	30.43

Note: The percentages (%) are rounded to the second decimal point. Percentages may not total 100 because of rounding.

Table 4 shows that approximately 28.99% of PTTES display strong ability in verbal creativity-flexibility ($T \geqq 55$), around 34.06% exhibit weak ability in verbal creativity-flexibility ($T \leqq 43$), and about 36.96% demonstrate relatively normal ability in verbal creativity-flexibility ($55 > T > 43$). The mean value of verbal creativity-flexibility for PTTES is 49.43, lower than that of Taiwanese undergraduates and postgraduates ($T = 54$, $N = 516$) (Wu et al., 1998).

Table 4
T *Scores and* PR *Values for Verbal Creativity- Flexibility among PTTES*

T Score Range	*PR* Value Range	*M*	*N*	%
55 and above	74 to 99	49.43	120	28.99
Between 43 and 55	41 to 66		153	36.96
Below 43	1 to 27		141	34.06

Note: The percentages (%) are rounded to the second decimal point. Percentages may not total 100 because of rounding.

Table 5 shows that about 26.81% of PTTES possess strong ability in verbal creativity-originality ($T \geqq 54$), approximately 25.36% show weak ability in verbal creativity-originality ($T \leqq 42$), and around 47.83% demonstrate relatively normal ability in verbal creativity-originality ($54 > T > 42$). The mean value of verbal creativity-originality for PTTES is 49.36, slightly lower than that of Taiwanese undergraduates and postgraduates ($T = 50$, $N = 516$) (Wu et al., 1998).

Table 5.
T *Scores and* PR *Values for Verbal Creativity- Originality among PTTES*

T Score Range	*PR* Value Range	*M*	*N*	%
54 and above	75 to 99	49.36	111	26.81
Between 42 and 54	30 to 70		198	47.83
Below 42	3 to 20		105	25.36

In Table 6, approximately 25.12% of PTTES are good at figural creativity ($T \geqq 219$), about 24.88% are weak at figural creativity ($T \leqq 178$), and around 50.00% demonstrate ordinary figural creativity ($219 > T > 178$). The mean value of figural creativity for PTTES is 198.73, lower than that of Taiwanese undergraduates and postgraduates ($T = 207$, $N = 516$) (Wu et al., 1998).

Table 6
T *Scores and* PR *Values for Figural Creativity among PTTES*

T Score Range	*PR* Value Range	*M*	*N*	%
219 and above	75 to 99	198.73	104	25.12
Between 178 and 219	26 to 74		207	50.00
Below 178	1 to 25		103	24.88

Table 7 presents that around 26.57% of PTTES show strong ability in figural creativity-fluency ($T \geqq 56$), approximately 25.60% exhibit weak ability in figural creativity-fluency ($T \leqq 42$), and about 47.83% demonstrate ordinary figural creativity-fluency ($56 > T > 42$). The mean value of figural creativity-fluency for PTTES is 49.36, lower than that of Taiwanese undergraduates and postgraduates ($T = 53$, $N = 516$) (Wu et al., 1998).

Table 7
T *Scores and* PR *Values for Figural Creativity-Fluency among PTTES*

T Score Range	*PR* Value Range	*M*	*N*	%
56 and above	76 to 99	49.36	110	26.57
Between 42 and 56	30 to 70		198	47.83
Below 42	1 to 23		106	25.60

Table 8 shows that approximately 26.09% of PTTES possess strong ability in figural creativity-flexibility ($T \geqq 57$), around 34.78% exhibit weak ability in figural creativity-flexibility ($T \leqq 44$), and about 39.13% demonstrate ordinary figural creativity-flexibility ($57 > T > 44$). The mean value of figural creativity-flexibility for PTTES is 49.42, lower than that of Taiwanese undergraduates and postgraduates ($T = 54$, $N = 516$) (Wu et al., 1998).

Table 8.
T *Scores and* PR *Values for Figural Creativity-Flexibility among PTTES*

T Score Range	*PR* Value Range	*M*	*N*	%
57 and above	78 to 99	49.42	108	26.09
Between 44 and 57	40 to 66		162	39.13
Below 44	1 to 28		144	34.78

Table 9 shows that about 28.02% of PTTES exhibit strong ability in figural creativity-originality ($T \geqq 55$), approximately 26.09% show weak ability in figural creativity-originality ($T \leqq 42$), and around 45.89% demonstrate ordinary figural creativity-originality ($55 > T > 42$). The mean value of figural creativity-originality for PTTES is 49.28, slightly lower than that of Taiwanese undergraduates and postgraduates ($T = 52$, $N = 516$) (Wu et al., 1998).

Table 9
T *Scores and* PR *Values for Figural Creativity- Originality among PTTES*

T Score Range	*PR* Value Range	*M*	*N*	%
55 and above	74 to 99	49.28	116	28.02
Between 42 and 55	29 to 70		190	45.89
Below 42	1 to 24		108	26.09

Table 10 shows that approximately 30.68% of PTTES possess strong ability in figural creativity-elaboration ($T \geqq 54$), about 31.88% exhibit weak ability in figural creativity-elaboration ($T \leqq 43$), and around 37.44% demonstrate ordinary figural creativity-elaboration ($54 > T > 43$). The mean value of figural creativity-elaboration

for PTTES is 49.24, slightly higher than that of Taiwanese undergraduates and postgraduates ($T = 48$, $N = 516$) (Wu et al., 1998).

Table 10.
T *Scores and* PR *Values for Figural Creativity- Elaboration among PTTES*

T Score Range	*PR* Value Range	*M*	*N*	%
54 and above	73 to 99	49.24	127	30.68
Between 43 and 54	39 to 63		155	37.44
Below 43	4 to 25		132	31.88

This study underscores the significance of establishing creativity norms for PTTES, facilitating a deeper understanding of their creative capacities relative to a broader educational context. However, PTTES' creativity performed slightly lower than that of Taiwanese undergraduates and postgraduates except for figural creativity elaboration. Based on the results from Tables 2 to 10, this study elaborates on the applicability and usage, timing and implementation, target groups, interpretation, and applications in educational settings for these creativity norms in response to the invaluable feedback provided on the clarity and application of the creativity norms for PTTES. In terms of applicability and usage, the creativity norms developed in this study are designed specifically to assess the creativity levels of PTTES in Taiwan. These norms provide benchmarks against which individual PTTES's creativity scores can be compared. They are crucial for identifying creativity levels across different segments of the population—postgraduates, undergraduates, and non-TCSOL major students in credit programs—thus enabling tailored educational interventions. In timing and implementation, the creativity norms are based on data collected through the New Creativity Test, which was administered at a single point in time (2018-2019) as a cross-sectional study. The test implementation was carried out in classroom settings across various TCSOL programs, ensuring the timing was consistent, and interference from external variables was minimized. Establishing creativity norms for PTTES involves short-term and long-term evaluations to accurately reflect changes in their capabilities and societal values over time. Wai and Halpern (2018) mention that long-term evaluations of the impact of

changing norms in psychological science are crucial as they provide insights into the sustained effects of educational policies and practices on creativity over generations. Such assessments aid in grasping the deeper and enduring impacts of shifts in educational standards on creativity, thereby guiding future adjustments and improvements in educational strategies and policies. Given the dynamic nature of creativity, which can be influenced by numerous factors, including educational practices, cultural shifts, and technological advancements (Li et al., 2022), it is advisable to review and potentially update the creativity norms every 5 to 10 years or the time of revised tests coming out (North Carolina Psychology Board, 2022).

As for the target groups, the creativity norms are intended for a wide range of stakeholders within the TCSOL community, including researchers, educators, publishers, and even company supervisors. By understanding where PTTES stand relative to these norms, they can better support areas of weakness and leverage strengths in creative capacities. Furthermore, the *T* scores and *PR* values reported in the tables provide a dual approach to interpreting student performance. *T* scores offer a standardized way to compare individual performance against the norm, while PR values clearly indicate how a student performs relative to peers. Based on numerical data in Tables 2 to 10, the established creativity norms are instrumental for educators in TCSOL programs to design interventions that specifically address the needs identified through normative comparisons. For instance, PTTES scoring below the normative range for fluency, flexibility, and originality might benefit from targeted exercises that foster divergent thinking and problem-solving skills. For those who are scoring below the normative range for flexibility, which involves the ability to employ various approaches and adapt thinking to new situations, a highly effective targeted exercise is scenario-based learning, exposing them to varied TCSOL scenarios to boost an essential component of TCSOL flexibility by developing multiple solutions for diverse challenges fosters creativity. These insights are invaluable for adapting appropriate instructional methods that foster creativity, catering to the distinct needs of future educators in the TCSOL field.

B. Comparison between Male and Female PTTES' Creativity

The independent sample *t*-test results indicate no significant difference in verbal creativity between male and female PTTES (fluency t = -.580, flexibility t = .920, originality t = -.183) nor in their figural creativity (fluency t = .491, flexibility t = 1.817, originality t = .682, elaboration t = 1.237). Cohen (1992) suggested that d = 0.2 be considered a "small" effect size, 0.5 represents a "medium" effect size. Refer to Table 11 for detailed comparisons.

Table 11

Comparison of Creativity Between Male and Female PTTES

Score / Item	Male (N = 49)		Female(N = 364)		t	d
	M	*SD*	*M*	*SD*		
Verbal Creativity						
Fluency	11.43	6.27	10.93	5.62	-.580	.083
Flexibility	6.73	3.52	7.19	3.24	.920	.135
Originality	6.59	6.82	6.43	5.62	-.183	.025
Figural Creativity						
Fluency	14.92	6.12	15.36	5.84	.491	.073
Flexibility	8.90	3.77	9.74	2.94	1.817	.248
Originality	10.84	6.05	11.49	6.29	.682	.105
Elaboration	3.80	4.38	4.52	3.75	1.237	.176

Note: "*N*" represents the sample size, "*M*" represents the mean, and "*SD*" represents the standard deviation.

C. Comparison of Creativity among PTTES in Different TCSOL Programs

This study found the mean values of original scores and *T* scores for verbal and figural creativity among PTTES enrolled in different TCSOL programs. For verbal creativity, PTTES in postgraduate programs demonstrated higher mean scores in fluency (M = 13.10, SD = 6.92; T = 53.73, SD = 12.17), flexibility (M = 7.58, SD = 3.63; T = 51.37, SD = 11.10), and originality (M = 8.53, SD = 7.39; T = 53.61, SD = 12.82) compared to their counterparts in undergraduate and credit programs. Conversely, PTTES in credit programs showed the highest mean scores for all components of figural creativity, surpassing those in postgraduate and undergraduate programs.

Specifically, the mean scores for verbal creativity-fluency were 13.10 (*SD* = 6.92; *T* = 53.73, *SD* = 12.17) for postgraduates, 10.09 (*SD* = 4.98; *T* = 48.43, *SD* = 8.75) for undergraduates, and 11.50 (*SD* = 5.79; *T* = 50.90, *SD* = 10.19) for credit program students, with a total mean score of 10.98 *(SD* = 5.69; *T* = 50.00, *SD* = 10.01). In terms of verbal creativity-flexibility, the mean scores were 7.58 (*SD* = 3.63; *T* = 51.37, *SD* = 11.10) for postgraduates, 6.96 (*SD* = 3.23; *T* = 49.45, *SD* = 9.90) for undergraduates, and 7.22 (*SD* = 3.04; *T* = 50.27, *SD* = 9.31) for credit program students, with a total mean score of 7.14 (*SD* = 3.27; *T* = 50.00, *SD* = 10.01). For verbal creativity-originality, the mean scores were 8.53 (*SD* = 7.39; *T* = 53.61, *SD* = 12.82) for postgraduates, 5.30 (*SD* = 4.42; *T* = 48.00, *SD* = 7.68) for undergraduates, and 7.63 (*SD* = 6.52; *T* = 52.05, *SD* = 11.31) for credit program students, with a total mean score of 6.45 (*SD* = 5.76; *T* = 50.00, *SD* = 10.01).

When examining figural creativity, the mean scores for figural creativity-fluency were 14.66 (*SD* = 6.14; *T* = 48.90, *SD* = 10.48) for postgraduates, 14.98 (*SD* = 5.46; *T* = 49.44, *SD* = 9.31) for undergraduates, and 16.62 (*SD* = 6.42; *T* = 52.24, *SD* = 10.96) for credit program students, with a total mean score of 15.31 (*SD* = 5.86; *T* = 49.99, *SD* = 10.01). For figural creativity-flexibility, the mean scores were 9.49 (*SD* = 2.81; *T* = 49.48, *SD* = 9.18) for postgraduates, 9.50 (*SD* = 3.07; *T* = 49.51, *SD* = 10.02) for undergraduates, and 10.14 (*SD* = 3.21; *T* = 51.60, *SD* = 10.48) for credit program students, with a total mean score of 9.65 (*SD* = 3.06; *T* = 49.97, *SD* = 9.99). In figural creativity-originality, the mean scores were 10.65 (*SD* = 6.12; *T* = 48.81, *SD* = 9.79) for postgraduates, 10.97 (*SD* = 6.08; *T* = 49.31, *SD* = 9.73) for undergraduates, and 13.03 (*SD* = 6.53; *T* = 52.61, *SD* = 10.45) for credit program students, with a total mean score of 11.40 (*SD* = 6.25; *T* = 50.02, *SD* = 10.00). Lastly, for figural creativity-elaboration, the mean scores were 3.51 (*SD* = 2.69; *T* = 47.61, *SD* = 7.02) for postgraduates, 4.56 (*SD* = 3.50; *T* = 50.38, *SD* = 9.13) for undergraduates, and 4.79 (*SD* = 5.10; *T* = 50.95, *SD* = 13.30) for credit program students, with a total mean score of 4.42 (*SD* = 3.83; *T* = 50.02, *SD* = 10.00).

The detailed analysis underscores the variances in creative abilities across different educational settings within TCSOL, offering insights into how program level might influence creativity.

Table 12 further reveals significant differences in verbal and figural creativity among PTTES across different TCSOL programs, as determined by MANOVA analysis (Wilk's λ = .866, MANOVA $F = 4.306$, $p < .001$).

Table 12

Comparison of Creativity among PTTES in Different TCSOL Programs

Score / Item	Postgraduates ($N = 77$)		Undergraduates ($N = 239$)		Non-TCSOL Major Students in Credit Programs ($N = 98$)		*F*-test	Scheffé	ηp^2	Observed Power
	M	*SD*	*M*	*SD*	*M*	*SD*				
Verbal Creativity										
Fluency	13.10	6.92	10.09	4.98	11.50	5.79	9.067***	P > U	.042	.974
Flexibility	7.58	3.63	6.96	3.23	7.22	3.04	1.117 *n.s.*	-	.005	.246
Originality	8.53	7.39	5.30	4.42	7.63	6.52	12.537***	P > U N > U	.057	.996
Figural Creativity										
Fluency	14.66	6.14	14.98	5.46	16.62	6.42	3.347*	*n.s.*	.016	.631
Flexibility	9.49	2.81	9.50	3.07	10.14	3.21	1.652 *n.s.*	-	.008	.348
Originality	10.65	6.12	10.97	6.08	13.03	6.53	4.539*	N > P	.022	.771
Elaboration	3.51	2.69	4.56	3.50	4.79	5.10	2.832 *n.s.*	-	.014	.555
Wilk's λ = .866							MANOVA $F = 4.306$***			

Note:

1. *N* represents the sample size, *M* represents the mean, and *SD* represents the standard deviation.
2. "*n.s.*" denotes not significant.Δ
3. "*" indicates $p < .05$, "***" indicates $p < .001$.
4. "ηp^2" represents partial eta squared, a measure of effect size, with values not more significant than .06 indicating small effect sizes.
5. "Observed Power" indicates the probability of correctly identifying an actual effect.
6. "P" represents "Postgraduates," "U" represents "Undergraduates," and "N" represents "Non-TCSOL Major Students in Credit Programs."

As shown in Table 12, differences in verbal creativity, specifically in fluency ($F = 9.067$, $p < .001$) and originality ($F = 12.537$, $p < .001$), were significant, as were differences in figural creativity in fluency ($F = 3.347$, $p < .05$) and originality ($F = 4.539$, $p < .05$). Scheffé's post hoc comparisons further revealed that postgraduates significantly

outperformed undergraduates in verbal creativity-fluency, with an observed power of .974, indicating a 97.4% probability of accurately detecting a genuine effect. Moreover, verbal creativity-originality was significantly higher in both postgraduates and non-TCSOL major students in credit programs compared to undergraduates, with an observed power of .996, suggesting a 99.6% probability of identifying an actual significant difference. In figural creativity, non-TCSOL major students in credit programs exhibited significantly higher originality than postgraduates, with an observed power of .771, equating to a 77.1% probability of correctly identifying a genuine effect. No significant differences were observed in figural creativity-fluency among the three groups. According to Cohen (1988), a partial eta squared (ηp^2) value of less than .06 denotes small effect sizes. For detailed statistics, refer to Table 12.

V. Discussion

A. Creativity Norms for PTTES

Based on establishing the creativity norms and subsequent comparisons, this study determined that PTTES excels beyond Taiwanese undergraduates and postgraduates from other disciplines in figural creativity-elaboration. The result indicates their proficiency in modifying and expanding upon original concepts with new ideas. However, PTTES' fluency, flexibility, and originality performance are considered satisfactory. The global surge in learning Chinese has prompted the establishment of numerous TCSOL educational programs in Taiwan. Nonetheless, for many Taiwanese students, choosing TCSOL as a major is neither highly favored nor strongly avoided, often depending on their admission scores. In essence, when selecting TCSOL, students find it ranked intermediately among other majors, and the admission scores for TCSOL students are average compared to those for English, Japanese, or education-related majors. A positive and substantial correlation exists between intelligence and creativity (Hussain, 1998), making these findings highly relevant to the current state of Taiwanese higher education.

This study significantly contributed to understanding the creative capabilities of PTTES by establishing creativity norms. Despite the scarcity of empirical research on

TCSOL creativity, this study surveyed 414 PTTES, evaluating their verbal and figural creativity to establish creativity norms that explore their current degree of creativity. Norms change depending on gender, age, race, and discipline (Chiou, 2005), necessitating their regular update to stay relevant across different contexts. Aligning with Yeh (2004), this study reinforces that creativity assessment aims not to segregate students into creative and non-creative cohorts but to help educators recognize students' creative levels and cultivate a conducive learning atmosphere.

B. Gender Differences in Creativity

This study identified no significant differences in creativity between male and female PTTES. Torrance (1974) suggested omitting creativity tests to prevent gender bias, yet research on gender differences in creativity has been explored for two decades, yielding varied results. Previous studies have shown superior male creativity (Tsai, 2013), higher female creativity (Cheung & Lau, 2010; Nadeem & Wani, 2013), and no significant differences between genders (Baer & Kaufman, 2008; Kaufman, 2006; Kogan, 1974). Creativity is influenced by more than just gender, including personal and professional competence, intrinsic motivation, socio-cultural background, personality, and environment. Diverse research tools and participant groups lead to different outcomes. For instance, Oral et al. (2007), using the Alternate Uses Test and the Consequences Test, found no significant gender differences in Turkish pupils' creativity. However, girls outperformed boys in the Consequences Test. The TTCT, applied by Stoltzfus et al. (2011), indicated better creativity among male students. He and Wong (2011) observed distinct creativity performances between boys and girls on various test items. In this study, PTTES from different TCSOL programs showed no significant gender differences in creativity, with verbal and figural creativity appearing similar. This result aligns with Baer and Kaufman's (2008) assertion that creativity between genders is comparable.

C. Differences in Creativity Among TCSOL Programs

Exploring the impact of educational backgrounds and other factors as independent variables on creativity is well-established in creativity research (Tsai, 2013; Wu et al.,

2005; Yeh & Li, 2008). For instance, Tian and Zhang (2010) utilized Williams' Creativity Assessment Packet (CAP), finding that approximately 30% of college students exhibited good performance. Tsai (2013) noted no significant difference in creativity between postgraduate and doctoral students despite an average age of 42.67 years for both groups. This study extends existing research on pre-service teacher creativity by examining differences across three TCSOL program types—undergraduate, postgraduate, and credit programs. Findings reveal that in verbal creativity-fluency and originality, TCSOL postgraduates outperformed TCSOL undergraduates. Similarly, non-TCSOL major students in credit programs excelled in verbal creativity-originality over TCSOL undergraduates. In figural creativity-originality, non-TCSOL major students in credit programs surpassed TCSOL postgraduates. The results might be attributed to postgraduates' advanced coursework and research exposure, fostering more profound engagement with theoretical frameworks and critical thinking and enhancing creative thinking and problem-solving abilities (Fleith, 2019; Truran, 2016). Additionally, the broadened perspectives and novel idea generation could stem from the diverse life experiences of postgraduates, particularly non-traditional adult learners (Richardson et al., 2022; Leung et al., 2008). Work experience may also contribute to individual creativity, as postgraduates seeking career advancement or upskilling bring valuable real-world experiences into the educational setting (Shi et al., 2023; Richardson et al., 2022; Ramos et al., 2018; McKay et al., 2022; Ohly, 2018; Inam et al., 2021). Non-TCSOL major students enrolled in credit programs surpassed TCSOL undergraduates in verbal creativity-originality. This difference might be attributed to the focused nature of these programs, which potentially offer a more tailored educational experience, as suggested by Ulicna (2011). Additionally, the inherent abilities of non-TCSOL major students and the influence of their professional disciplines could contribute to their elevated creativity levels. Nonetheless, this hypothesis necessitates further investigation due to the absence of direct evidence.

Interestingly, this study also found that non-TCSOL major students in the credit program exhibited greater figural creativity-originality than TCSOL postgraduates. This discovery highlights the need for further investigation, especially compared to previous research conducted by Wu et al. (1998), which showed that Taiwanese undergraduates

and postgraduates demonstrated a higher level of figural creativity-originality than was observed in this study for PTTES. Additional evidence indicates that art majors score higher in figural creativity than non-art majors (Xurui et al., 2018). It is conceivable that non-TCSOL major students in the credit programs, coming from diverse fields such as art, design, information technology, etc., are more inclined towards figural knowledge and skills than TCSOL postgraduates. This disparity in educational backgrounds could account for the superior performance in figural creativity-originality observed among non-TCSOL major students in the credit programs. While the current body of research on this specific comparison is limited, these findings hint at the significant impact that program structure, educators' pedagogical approaches, and individual experiences may have on creativity development. By initiating an analysis of creativity among PTTES across different TCSOL programs, this study suggests that further investigation into the demographics, previous educational backgrounds, and motivations for program enrollment could illuminate the factors influencing the noted differences in creativity.

D. Implication for Creativity Teaching

The environment is a crucial element in inspiring human creativity, as corroborated by prior research (Amabile, 1997; Csikszentmihalyi, 1999; Fan & Cai, 2022; Gardner, 2011; Sternberg, 2006; Liu et al., 2020; Ritter et al., 2020). Scott et al. (2004) emphasized that well-designed creativity training programs that develop cognitive skills through realistic exercises can enhance creativity. This study's CREATIVE Flower Model (Figure 1) offers a framework for inspiring creativity in Pre-service TCSOL teacher education courses, addressing real-world issues encountered in Chinese language classes.

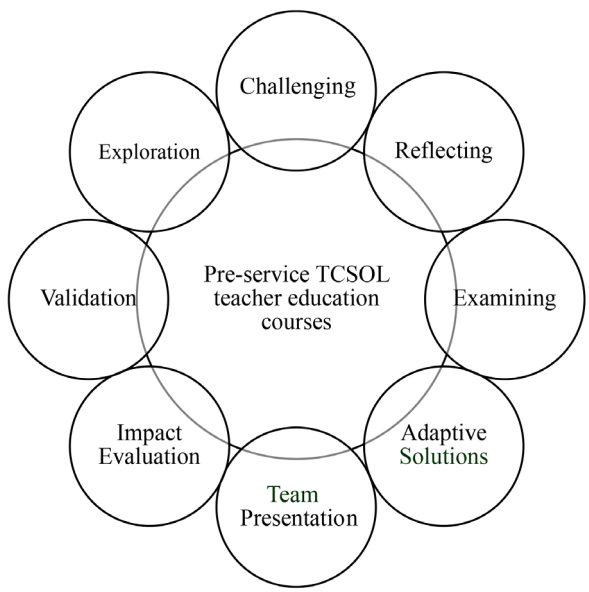
The CREATIVE Flower Model outlines a comprehensive approach to nurturing creativity among PTTES in TCSOL programs. This model introduces eight strategic steps:

1. Challenging: Identifying real-world problems within Chinese language teaching.
2. Reflecting: Facilitating team discussions to inspire creative solutions.
3. Examining: Analyzing the root causes of these challenges through inductive reasoning.
4. Adaptive Solutions: Developing innovative responses to these challenges.

5. Team Presentation: Sharing and showcasing creative ideas and solutions.
6. Impact Evaluation: Measuring the effectiveness and practicality of the proposed solutions.
7. Validation: Confirming the applicability of these solutions in actual teaching scenarios.
8. Exploration: Promoting ongoing exploration and adaptation of new pedagogical methods.

Figure 1

A CREATIVE Flower Model of Inspiring Creativity for PTTES



By implementing the CREATIVE Flower Model, this study aims to significantly boost the creative potential of PTTES in TCSOL. However, the current landscape shows minimal proactive engagement from students specializing in TCSOL in addressing and enhancing teaching methodologies. Future research is imperative to bridge this gap. Accordingly, this study recommends that educators in TCSOL programs should motivate PTTES to bring forth and discuss relevant and practical challenges encountered during their training. Such issues should act as springboards for enriching classroom discussions.

A common obstacle TCSOL teachers face is establishing a conducive Chinese-only learning environment to immerse learners fully in the language, challenging the traditional reliance on their native languages. This situation becomes particularly problematic when teaching beginners exclusively in Chinese. While using English for instruction in beginner classes may facilitate learning for those proficient in English, it could alienate learners lacking English proficiency. The dilemma between exclusive Chinese instruction and bilingual teaching remains unresolved, highlighting TCSOL educators' need to lead PTTES in exploring viable solutions to the challenges faced in TCSOL instruction.

Educators in TCSOL programs should initiate dialogues by posing questions such as, "How do Chinese L2 learners react to exclusively Chinese instruction compared to bilingual teaching?" and "What alternative strategies could effectively address the needs of Chinese L2 learners?" Such inquiries can foster productive discussions and lead to innovative solutions. Furthermore, integrating external resources like technology and the immediate environment can enrich the learning experience, enhancing student engagement and fostering a deeper connection with the subject matter. This strategy boosts participation and motivation (Zuber-Skerritt, 2002) and enables educators to create diverse and creative learning themes, thus cultivating students' creativity and broadening their knowledge base.

In addition to the common instructional skills above, this study also offers the applications of the CREATIVE Flower Model to inspire creativity for each group of PTTES—postgraduate, undergraduate, and credit program students—based on the findings of the study:

To postgraduate PTTES, who exhibited significantly higher verbal creativity-fluency and originality compared to their undergraduate peers, the "Challenging" component of the model can leverage these findings by urging postgraduate PTTES to undertake tasks that demand higher levels of critical thinking and problem-solving in a linguistically rich environment. They can also deepen their understanding and enhance their creative output through reflective discussions. Furthermore, educators can integrate real TCSOL cases into curricula, encouraging postgraduate PTTES to dissect and solve these cases creatively. Postgraduate PTTES, however, demonstrated substantially lower

levels of figural creativity-originality. The "Adaptive Solutions" component of the CREATIVE Flower Model will likely be the most impactful component for enhancing figural creativity-originality in postgraduate PTTES. To develop robust figural creativity skills, crafting innovative solutions and actively creating and utilizing tools that promote innovation and originality is crucial. Postgraduate PTTES could, for instance, be instructed to use AI-powered tools such as Image Creator, Midjourney, Adobe Express Animation, Auto Draw, Coplit, and Portaly. Assigning projects that require the creation of visualizations, such as infographics, animation, videos, or interactive online learning resources tailored for TCSOL settings, can also be beneficial. Training postgraduate PTTES in these AI-powered tools and in how to tackle visual creation tasks will help them become professional TCSOL teachers. By pushing their originality and design skills, postgraduate PTTES improve their figural creativity while acquiring practical, in-demand skills highly valued in contemporary TCSOL settings.

For undergraduate PTTES who exhibit lower levels of verbal creativity-fluency and originality, leveraging the "Team Presentation" and "Impact Evaluation" components of the model can be beneficial. Collaborating in teams can help enhance their creative confidence and communication skills. Presenting creative ideas in groups can cultivate a sense of achievement and stimulate creative engagement. For instance, educators can offer role-play exercises to simulate TCSOL scenarios to address Chinese linguistic and cross-cultural issues. At the same time, debates encourage critical thinking through structured arguments on real challenges in TCSOL. Additionally, micro TCSOL allows undergraduate PTTES to develop creative teaching methods to train Chinese L2 learners' comprehensive knowledge and skills. After these activities, undergraduate PTTES engage in reflective journals and structured feedback sessions to critically assess and refine their approaches. This methodological integration fosters collaborative learning and encourages continuous personal and professional development in TCSOL. Furthermore, educators can utilize the "Validation" and "Exploration" components to encourage undergraduate PTTES to validate their ideas through peer and educator feedback, cultivating a responsive learning atmosphere. During the validation phase, undergraduate PTTES are encouraged to engage in peer review sessions where they present their TCSOL strategies and receive constructive feedback from classmates and educators. This

iterative process improves their ability to express creative ideas clearly and fluently and fosters a deeper understanding of creative TCSOL practices. Exploration stages can involve cross-disciplinary modules integrating elements from arts, history, or technology with TCSOL to broaden their creative perspectives. For instance, educators might encourage undergraduate PTTES to explore how Chinese calligraphy can enhance linguistic skills, how authentic materials can be used to teach Chinese language constructs, or how easy drawings can be integrated to make Chinese vocabulary learning more engaging. Such integrative approaches broaden the undergraduate PTTES' creative perspectives and enhance their ability to connect with diverse Chinese L2 learners.

To the PTTES enrolled in credit programs who have demonstrated proficiency in figural creativity-originality, it is suggested that they can contribute diverse perspectives from their respective disciplines. Integrating their varied backgrounds with TCSOL concepts can lead to innovative teaching methods and materials. Assigning projects that require PTTES to merge their disciplinary knowledge with TCSOL can be an effective approach. For example, PTTES with backgrounds in computer education could create online games tailored to learning Chinese characters, vocabulary, patterns, and grammar. Additionally, PTTES with skills in graphic design, creative writing, multimedia, or arts can create e-storybooks that narrate classical Chinese tales or day-to-day scenarios to enhance vocabulary, grammatical, and cultural knowledge. These storybooks could include interactive elements like clickable text that plays audio of the word’s pronunciation or embedded quizzes to test comprehension. Moreover, educators can also organize teams with diverse disciplinary majors for mutual teaching and learning, where PTTES can collaborate with experts from different majors to explore new TCSOL methods. For instance, instructing the PTTES to apply what they have learned and their newly acquired knowledge to design and implement game-based TCSOL activities for online and in-person classes could lead to helping Chinese L2 learners practice the Chinese language in enjoyable contexts, enhancing verbal and non-verbal communication skills. Additionally, leveraging the “Adaptive Solutions” and “Team Presentation” components of the CREATIVE Flower Model can reinforce PTTES' creative strengths and address any gaps in their TCSOL-specific knowledge. For example, PTTES with a background in psychology could share effective ways of finding comforts that adapt

based on the emotional responses of Chinese L2 learners who encountered difficulties in learning Chinese and culture shock. In "Team Presentation," it could be highly effective to organize teamwork where PTTES collaborate across disciplines to design and present comprehensive country-specific and learner-centered TCSOL materials and methods. Each team could tackle a different aspect of language learning, such as Chinese language knowledge, pronunciation, skills for listening, speaking, reading, writing, and multicultural etiquette, integrating their diverse expertise to create a holistic learning experience.

Drawing from years of experience in TCSOL programs, I have observed that creative teaching methods can establish a supportive and non-threatening environment reminiscent of the Suggestopedia approach, thereby nurturing PTTES' creativity. A variety of factors influence the performance of PTTES. Empirical research highlights that educators play a crucial role in developing a foundational understanding of the individual's relationship with society, enhancing professional skills, and addressing inquiries during the learning process (Chen & Leou, 2007; Lien & Hsiung, 2010; Koçoglu, 2009). PTTES often emulate observed teaching styles and methodologies, applying them in future teaching scenarios. Creativity forms the cornerstone of innovative Chinese teaching, distinguishing the Taiwanese TCSOL approach from mainland China, and remains a focal point for current and future educational efforts.

VI. Conclusion

A. Unpacking Creativity and Nurturing Diverse Creative Strengths for PTTES

Insights have been delineated in this study, revealing significant findings about the creativity of PTTES. Firstly, the figural creativity-elaboration of PTTES is slightly higher than that of Taiwanese undergraduates and postgraduates, while other creativity of PTTES is somewhat lower. Additionally, there is no discernible difference in verbal and figural creativity between male and female PTTES, indicating gender does not influence creative performance in this context. Thirdly, postgraduate PTTES possess significantly higher verbal creativity-fluency and originality than undergraduate PTTES, with PTTES

in credit programs outperforming undergraduate PTTES in verbal creativity-originality. Notably, the figural creativity-originality of PTTES in credit programs surpasses that of postgraduate PTTES, underscoring diverse areas of creative strengths across different educational programs and disciplines. These findings underscore the complex interplay between educational level, discipline, and creative abilities among PTTES, highlighting the need for tailored educational strategies to nurture creativity effectively.

Recognizing this complexity calls for a shift in focus within pre-service TCSOL education. Instead of a one-size-fits-all approach aimed at fostering creativity in a generic sense, educators should strive to uncover and nurture the diverse creative strengths resident within each PTTES. This feat can be achieved through differentiated instruction tailored to the specific needs and existing creative abilities of individual students. Furthermore, fostering a collaborative learning environment where PTTES can learn from and inspire one another can enhance creativity development. By adopting strategies of the CREATIVE Flower Model, TCSOL programs can equip PTTES with a well-rounded set of creative skills, allowing them to adapt and thrive in a quality education aligned with sustainable development goals, where innovative teaching methods are crucial for preparing PTTES to be professional and competitive TCSOL teachers for the complexities of the 21st century.

B. Implication for Future Research

Analyzing and comparing the verbal and figural creativity of PTTES to develop norms has been a pivotal task in this study. While comparing findings with different studies can be enlightening, the inherent limitations of such comparisons must be acknowledged. Such limitations stem from the variations in sample characteristics, assessment tools, and timeframes, which can hinder drawing definitive conclusions about differences across populations. Future research should aim for replications using consistent methodologies and sample characteristics to enhance the generalizability of findings and establish and validate creativity assessments for PTTES in TCSOL programs.

It is crucial to have a sufficiently large sample size to ensure the validity and generalizability of psychological norms with *T* scores and PR values. In the context of

this study, where the objective is to develop creativity norms for PTTES, the use of a sample size of 414 participants aligns well with the recommended practices for the minimum for creating robust normative data with at least 300 participants (Chien & Yao, 2014; Kaplan & Saccuzzo, 2017). However, the non-continuous cutting points in PR values, causing a potential limitation in the creativity norm development process, might be attributed to the inherent variability and distribution characteristics of the creativity scores among the participants. Future research could address the issue by increasing the sample size to provide a more granular distribution of scores and regularly updating the creativity norms by conducting longitudinal studies to track changes in creativity among PTTES over time.

Additionally, the gender imbalance, with a male-to-female ratio of 20:80 in Taiwanese TCSOL programs, affects the generalizability of findings related to gender differences in creativity, even if normality testing mitigates this issue. Future studies are encouraged to use stratified sampling techniques to recruit more male participants or to focus on programs with a more balanced gender ratio, ensuring a more comprehensive comparison across genders beyond purposive sampling.

Furthermore, this study's cross-sectional design, capturing a momentary snapshot of creativity levels and discussions grounded in existing literature, hints at potential explanations for observed differences, such as varied exposure to advanced coursework, life experiences, and program foci. Future directions could include longitudinal studies to monitor creativity development over time and across different program types. This approach would offer a deeper understanding of the impact of diverse educational structures and experiences on both male and female PTTES' creativity. Additionally, integrating quantitative and qualitative methodologies to investigate the effects of variables like academic background, enrollment motivation, and work experience on creativity variations could provide rich insights. By conducting interviews or focus groups, researchers could gain a nuanced understanding of students' experiences, motivations, learning environments, and perceptions of creativity. This comprehensive exploration would extend beyond measuring creativity among PTTES to assessing their TCSOL creative output and examining the correlation between creativity and innovative TCSOL methods.

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Appendix 1

新編創造思考測驗 [1]

The New Creativity Test

等候指示，再開始作答

Wait for instructions before beginning

[1] "New Test for Verbal Creativity" and "New Test for Figural Creativity" were compiled by Professor Jing-Jyi Wu and are used with permission. "Basic personal information" was added based on the purpose of this study.

一、新編語文創造思考測驗 New Test for Verbal Creativity

竹筷子的不尋常用途

筷子和我們日常生活關係太密切了！筷子除了吃飯夾菜夾肉等食物外，當然也可以加其他的東西。筷子除了夾食物的功能以外，一定還有其他各種不同甚至有創意的用途，這個測驗的目的就是請你想想筷子還有哪些功能？請你將所想到的用途分別寫在畫線處，每一個畫線處寫一個用途，你所能想到的用途愈多愈好，每個用途寫得愈清楚愈具體愈好。

記住：你只能用竹子做的筷子，而且這些筷子的長短跟我們平常家裡吃飯用的差不多，你可以同時使用很多枝或很多雙筷子。（十分鐘）

Unusual Uses for Bamboo Chopsticks

Chopsticks are closely related to our daily life! Besides using chopsticks for eating and picking up food such as vegetables and meat, of course, they can also hold other items. Apart from the function of holding food, there must be various other different and even creative uses for chopsticks. The purpose of this test is for you to think about what other functions chopsticks might have. Please write down the uses you think of in the spaces provided, one use per line. The more uses you can think of, the better, and the clearer and more specific each use is written, the better.

Remember: You can only use chopsticks made of bamboo, and these chopsticks are about the same length as the ones we usually use at home for eating. You can use many sticks or pairs of chopsticks at the same time. (10 minutes)

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停！等候指示，再做第二部分。

Stop! Wait for instructions before moving on to the second part.

二、新編圖形創造思考測驗 New Test for Figural Creativity

人

「人」是個文字也是個圖形，在這個測驗裡是要你把「人」當成圖形而不是文字看待。下面總共有五十七個大小不盡相同的「人」形，看你在十分鐘之內能畫出多少個圖畫，「人」形必須是你所畫圖畫中的一部分，畫好之後請在每一幅圖畫下面畫線處寫出所畫圖形的名稱。記住，你所畫的圖畫不能是中文字。（十分鐘）

人 Person

" 人 (Person)" is both a word and a figure. In this test, you are to treat " 人 " as a figure, not as a word. Below are fifty-seven " 人 " shapes of varying sizes. See how many pictures you can draw in ten minutes, where the " 人 " shape must be part of your drawing. After drawing, please write the name of the figure you've drawn below each picture. Remember, the pictures you draw cannot be Chinese characters. (10 minutes)

1. 2. 3.

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三、個人基本資料 **Personal Basic Information**

1. 性別 Gender：☐男 Male ☐女 Female
2. 年齡 Age：_____
3. 就讀學校 School：_____
4. 修習師資培育中心課程情形 Course Enrollment Situation at the Teacher Education Center：
   ☐已修畢 Completed ☐正在修 Currently Enrolling ☐否 Not Enrolled
5. 取得「教育部對外華語教學能力認證」情形 Situation of Obtaining the Ministry of Education Certificate for Teaching Chinese to Speakers of Other Languages (TCSOL Certificate)：
   ☐已取得 Obtained ☐尚未取得 Not Yet Obtained
6. 華語教學實習經驗 TCSOL Internship Experience：☐有 Yes ☐無 No
7. 華語教學實際（全 / 兼職）經驗 TCSOL Practical (Full-/Part-Time) Experience：
   ☐有 Yes ☐無 No

Appendix 2

T *Scores and* PR *Values for Verbal Creativity among PTTES*

PR Values	Verbal Creativity	
	T scores	Cumulative Number
99	263	2
98	225	6
97	214	8
96	205	11
95	204	14
94	203	17
93	199	20
92	196	23
91	195	26
90	193	29
89	190	33
88	187	36
87	186	39
86	183	43
85	182	46
84	181	49
83	180	53
82	179	58
81	178	60
80	176	63
79	175	67
78	173	70
77	172	74
76	171	79
75	**170**	**83**
74	169	85
73	168	89
72	167	92
71	166	96
70	165	100
69	164	105

（Continued）

Appendix 2

T *Scores and* PR *Values for Verbal Creativity among PTTES*（*Continued*）

PR Values	Verbal Creativity	
	T scores	Cumulative Number
68	163	109
67	162	111
66	161.5	117
65	161	118
64	160	123
63	159	126
62	158.5	132
61	158	134
60	157.5	139
59	157	142
58	155	146
57	154.5	151
56	154	155
55	153	158
54	152.5	165
53	152	168
52	151.5	171
51	151	175
50	**150.5**	**181**
49	150.15	182
48	150	187
47	149	191
46	148.5	195
45	148	200
44	147.5	203
43	146	208
42	145.5	213
41	145	217
40	144	221
39	143.5	226
38	143	229
37	142	234
36	141.5	238
35	141	242

（Continued）

Appendix 2

T *Scores and* PR *Values for Verbal Creativity among PTTES*（*Continued*）

PR Values	Verbal Creativity	
	T scores	Cumulative Number
34	140	247
33	139.5	251
32	139	258
31	138	261
30	137.5	265
29	137	270
28	136.5	274
27	135	278
26	134.5	282
25	**134**	**290**
24	133.5	293
23	133	297
22	132	302
21	131	307
20	130.5	312
19	130	316
18	128.5	322
17	128	326
16	127	330
15	126.5	335
14	125.5	342
13	125	347
12	123.5	352
11	123	357
10	122	361
9	121.5	365
8	120	371
7	119	375
6	117	382
5	115	386
4	113	391
3	112.5	397
2	112	407
1	102	414

Appendix 3

T *Scores and* PR *Values for Verbal Creativity-Fluency among PTTES*

PR Values	Verbal Creativity-Fluency	
	T scores	Cumulative Number
99	81	4
98	74	7
97	72	12
96	69	17
95	67	20
93	65	36
90	64	42
88	62	51
85	60	69
81	58	85
77	57	104
72	55	121
68	53	145
62	51	165
56	50	193
49	48	229
41	46	254
34	44	288
27	42	317
20	41	345
13	39	375
7	37	391
3	35	407
1	32	414

Appendix 4

T *Scores and* PR *Values for Verbal Creativity-Flexibility among PTTES*

PR Values	Verbal Creativity-Flexibility	
	T scores	Cumulative Number
99	80	6
97	74	14
96	71	19
94	67	27
91	64	42
87	61	63
81	58	90
74	55	120
66	52	160
54	49	214
41	46	273
27	43	328
16	40	365
7	37	400
2	34	410
1	31	414

Appendix 5

T *Scores and* PR *Values for Verbal Creativity-Originality among PTTES*

PR Values	Verbal Creativity-Originality	
	T scores	Cumulative Number
99	87	5
98	78	9
97	73	13
96	70	17
95	68	19
94	66	27
92	64	34
90	63	43
89	61	49
87	59	59
84	57	73
79	56	94
75	54	111
70	52	137
63	50	165
56	49	193
49	47	226
40	45	266
30	44	309
20	42	351
11	40	383
3	38	414

Appendix 6

T *Scores and* PR *Values for Figural Creativity among PTTES*

PR Values	Figural Creativity	
	T scores	Cumulative Number
99	274	5
98	266	9
97	257	13
96	252	17
95	251	21
94	249	25
93	247	30
92	244	34
91	242	38
90	239	42
89	237	46
88	235	50
87	234	54
86	233	58
85	232	63
84	230	67
83	229	71
82	227	75
81	226	79
80	225	83
79	224	87
78	222	92
77	221	96
76	220	100
75	219	104
74	218.5	110
73	218	112
72	217	116
71	216.5	122
70	216	125
69	215	129
68	214	133
67	213	137

（Continued）

Appendix 6

T *Scores and* PR *Values for Figural Creativity among PTTES*（*Continued*）

PR Values	Verbal Creativity	
	T scores	Cumulative Number
66	212	141
65	210	145
64	209	150
63	208	154
62	207	158
61	206	162
60	205.5	168
59	205	170
58	204	175
57	203	179
56	202	183
55	201.5	190
54	201.3	192
53	201	195
52	200.5	202
51	200	205
50	199.5	208
49	198	212
48	197.5	218
47	197	220
46	196.5	224
45	196	228
44	195	232
43	194.5	240
42	194	244
41	193.5	246
40	193	249
39	192	253
38	191	257
37	190	261
36	189	265
35	188	270
34	187	274

（Continued）

Appendix 6

T *Scores and* PR *Values for Figural Creativity among PTTES*（*Continued*）

PR Values	Verbal Creativity	
	T scores	Cumulative Number
33	186	278
32	184	282
31	183	286
30	182	290
29	181	294
28	180	299
27	179	303
26	178.5	311
25	178	313
24	177	315
23	176	319
22	175	323
21	174.5	329
20	174	332
19	171	336
18	170	340
17	169	344
16	167.5	351
15	167	352
14	165	357
13	164	361
12	163	365
11	162.5	368
10	162	373
9	159.5	379
8	159	381
7	155	386
6	153	390
5	149	394
4	146	398
3	144	402
2	138	406
1	123	414

Appendix 7

T *Scores and* PR *Values for Figural Creativity-Fluency among PTTES*

PR Values	Figural Creativity-Fluency	
	T scores	Cumulative Number
99	78	5
98	71	9
97	69	15
96	68	18
95	66	24
92	64	38
89	63	48
86	61	64
83	59	74
80	58	89
76	56	110
70	54	135
64	52	161
57	51	190
50	49	220
43	47	248
37	46	271
30	44	308
23	42	323
19	40	344
14	39	367
9	37	383
6	35	392
4	34	403
1	28	414

（Continued）

Appendix 8

T *Scores and* PR *Values for Figural Creativity-Flexibility among PTTES*

PR Values	Figural Creativity-Flexibility	
	T Scores	Cumulative Number
99	73	5
98	70	9
96	67	19
92	64	43
86	60	67
78	57	108
66	54	168
52	51	223
40	47	270
28	44	321
18	41	356
11	38	380
6	34	393
4	31	400
2	28	405
1	21	414

Appendix 9

T *Scores and* PR *Values for Figural Creativity-Originality among PTTES*

PR Values	Figural Creativity-Originality	
	T Scores	Cumulative Number
99	76	4
98	71	9
97	70	11
96	68	17
95	66	25
92	65	36
90	63	44
87	62	57
84	60	70
82	58	79
78	57	98
74	55	116
70	54	133
65	52	156
58	50	186
51	49	216
44	47	246
36	46	278
29	44	306
24	42	318
20	41	340
16	39	354
12	38	375
7	36	386
4	34	404
1	31	414

Appendix 10

T *Scores and* PR *Values for Figural Creativity-Elaboration among PTTES*

PR Values	Figural Creativity-Elaboration	
	T Scores	Cumulative Number
99	77	6
98	75	9
97	69	14
96	67	19
94	64	27
91	61	41
88	59	59
82	56	90
73	54	127
63	51	175
52	48	216
39	46	282
25	43	335
14	41	376
4	38	414

徵稿啟事

2005.1.18 編輯委員會會議通過
2006.2.13 編輯委員會會議通過
2006.5.15 編輯委員會會議通過
2006.8.11 編輯委員會會議通過
2007.7.13 編輯委員會會議通過
2009.8.10 編輯委員會會議通過
2011.2.10 編輯委員會會議通過
2012.8.16 編輯委員會會議通過
2016.3.21 編輯會會議通過
2019.12.9 編輯會會議通過
2021.3.25 編輯會會議通過
2022.6.8 編輯會會議通過
2023.03.31 編輯會會議通過
2023.10.13 編輯會會議通過

《教育研究與發展期刊》（Journal of Educational Research and Development）為國家教育研究院發行之教育學術刊物，著重在教育領域內之研究與發展（R&D）方面相關議題，並推廣國內外教育學術研究與交流。所有稿件之徵、審稿辦法比照國家科學及技術委員會人文社會科學研究中心 TSSCI 期刊評比收錄標準之相關規定辦理，歡迎踴躍賜稿。

一、徵稿事項

（一）本刊為季刊，全年徵稿，每年 3 月、6 月、9 月、12 月出版，徵稿範圍包含「師資培育與教師專業發展」、「課程與教學」、「教育政策與制度」（含教育行政、學校行政等）、「教育心理、輔導與測評」（含：教育統計）等領域之原創性論文；自 112 年 1 月 1 日起，改僅以收錄上述四大領域在教育理論、政策與實務興革之研究，期透過各界對教育議題之探究與分析，蒐集並作為國家教育研究院進行教育理論與實務研究之重要參考。

（二）本刊自 109 年 16 卷 1 期開始，新增「研究趨勢評論」專欄。本刊編輯會亦得邀請各領域學者專家針對本刊四大領域的重要議題，以文獻探討或以科學方法，綜合評述該議題研究趨勢，引領各界進一步探究取徑。

（三）所有稿件皆隨到隨審，原則上，編輯部於收稿後五個月內處理完成並告知作者「刊登與否」。

二、投稿原則

（一）請以電腦打字，中英文不拘，中文撰稿文長以 15,000 字為原則 ，至多為 20,000 字（含中英文摘要、註釋、參考書目、附錄、圖表等），經審查通過之修正文稿字數不得超過 22,000 字。中文摘要請勿超過 500 字，英文摘要不超過 300 字，並列出中英文關鍵字至少各 3~5 個。如以英文撰稿，請勿超過 12,000 字。

（二）來稿請使用線上投稿系統，請有意投稿者至網址（http://140.122.97.163/index.php/JERD/login）註冊並上傳中英文摘要及全文電子檔（Word 或 PDF 格式），需詳細填列共同作者、服務機關、最高學歷、專長領域、聯絡電話、電子郵件等資訊，俾利編輯部確認身份。

（三）投稿正文及中英文摘要中， 請勿出現任何個人資料 。

（四）來稿文件之註釋（採當頁註方式）及參考書目，請用 APA 格式最新版。詳細規範可至本期刊網站下載說明文件，或來函（請附回郵信封）至編輯部索取。

（五）未依本刊所要求之格式來稿，本刊將逕予退稿。

（六）來稿如未獲採用，本刊將致函作者審查結果，但不寄還稿件，請投稿者自留原稿。

（七）本刊因編輯需要，保有必要之文字刪修權。

（八）兩名作者以上之稿件，應分別列明各人之貢獻。

（九）單一作者單期投稿並不限制 1 篇，但如當期該作者已通過審查之作品 2 篇以上，由本刊編輯會決定擇優刊登、刊登篇數及錄用期數；除當期選錄刊登作品外，告知作者通過作品預定刊登之期數並徵得其同意，刊登原則為一年之內。

三、著作財產權事宜

（一）為維學術倫理，請勿一稿多投，如有抄襲，改寫等侵犯他人著作權之情況者，由作者自負相關法律責任。

（二）本刊授權方式為非專屬授權（Non-exclusive License）予出版單位，來稿一經刊登，需於期限內簽署著作授權利用書掛號回寄編輯部。

四、稿件審查

（一）本刊所有稿件採雙向匿名內外審查制度，由本刊編輯委員聘請相關領域學者專家二人審查之。經審查委員審查結果屬修正後通過之文章，於作者修改之後再由編輯會決定是否刊登。

（二）凡本刊接受刊登之稿件，得視編輯需要，經編輯會同意後，擇期刊登。

Journal of Educational Research and Development Call for Papers

Jan. 18, 2005 Passed by the Editorial Board Meeting
Feb. 13, 2006 Passed by the Editorial Board Meeting
May 15, 2006 Passed by the Editorial Board Meeting
Aug. 11, 2006 Passed by the Editorial Board Meeting
Jul. 13, 2007 Passed by the Editorial Board Meeting
Aug. 10, 2009 Passed by the Editorial Board Meeting
Feb. 10, 2011 Passed by the Editorial Board Meeting
Aug. 16, 2012 Passed by the Editorial Board Meeting
Mar. 21, 2016 Passed by the Editorial Meeting
Dec. 09, 2019 Passed by the Editorial Meeting
Mar. 25, 2021 Passed by the Editorial Meeting
Jun. 08, 2022 Passed by the Editorial Meeting
Mar. 31, 2023 Passed by the Editorial Meeting
Oct. 13, 2023 Passed by the Editorial Meeting

The Journal of Educational Research and Development is an academic journal about education issued by the National Academy for Educational Research. It focuses on research and development (R&D) related issues in the field of education. It also promotes domestic and foreign educational academic research and exchanges. The methods for calls for papers and reviews shall be handled in accordance with the relevant regulations of the Taiwan Social Sciences Citation Index (TSSCI) of the Research Institute for Humanities and Social Sciences from National Science and Technology Council. The Journal welcomes paper submission.

1. Call for papers:

(1) This journal is a quarterly journal. Paper submissions are welcome throughout the year. It is published in March, June, September, and December of each year. The scope of focus in the original papers includes “Teacher Training and Teacher Professional Development,” “Curriculum and Teaching,” “Educational Policy and System” (including educational administration, school administration, and others.), “educational psychology, counseling and

evaluation" (including educational statistics). From January 1, 2023 onward, the Journal will only publish papers with topics in the above four educational areas related to theoretical innovation, innovative policy, and creative practices. Through a collection of research on educational theories and practices and analysis on educational issues, the Journal is expected to serve as an important reference for the National Academy for Educational Research.

(2) Starting from Volume 16, Issue 1, 2020, a new "Research Trends Review" column has been added. The editorial board of this journal can invite scholars and experts from various fields to discuss important issues in the four major fields of this journal and conclude the research trends of these issues through literature review or scientific methods. The goal is to lead different sectors of society in further exploring ways of doing things.

(3) All manuscripts are reviewed upon arrival. In principle, the editorial department will complete the review procedure within five months after receiving the manuscript and inform the author of whether the article will be published.

2. Notes for Submission

(1) Please type your paper on a computer. Both Chinese and English texts are welcome. The length of the manuscript written in Chinese should be within 15,000 words in principle, with a maximum of 20,000 words (including Chinese and English abstracts, footnotes, bibliography, appendices, charts, etc.) A paper that passes review and is revised should not exceed 22,000 words. The Chinese abstract should not exceed 500 words and the English abstract should not exceed 300 words. Please list at least 3 to 5 keywords in both Chinese and English. If written in English, please do not exceed 12,000 words.

(2) Please use the online submission system to submit manuscripts. Interested contributors are requested to register at the website: (http://140.122.97.163/index.php/JERD/login) and upload Chinese and English abstracts and full-text electronic files (Word or PDF format). Please list co-authors, affiliated institutions, highest degree received, areas of expertise, contact phone number, email and other information for verification of authors' identity by the editorial department.

(3) Please do not include any personal information in the body of the manuscript, Chinese abstract, and English abstract.

(4) Please use the latest version of APA formatting for the notes (in the form of footnotes) and bibliography in the submitted manuscript. Detailed specifications

can be downloaded from the journal's website, or obtained by a letter through mail (please attach a return envelope) to the editorial department.

(5) Manuscripts not submitted in the format required by this journal will be rejected.

(6) If the manuscript is not accepted, the journal will send a letter of review results to the author. The manuscript however will not be returned. It is the author's responsibility to keep the original manuscript.

(7) Due to editorial needs, this journal reserves the right to delete and modify the text when necessary.

(8) For manuscripts with more than two authors, the contributions of each author should be listed separately.

(9) There is no limit to the number of articles submitted by a single author in a single issue, but if the author has passed the review of more than 2 works in the current issue, the editorial committee of the journal will decide which article to be published, the number of articles to be published, and issues where articles will be published. In addition to articles that will be published in the current issues, the Editorial Department will inform the authors of the issues in which authors' paper(s) are scheduled to be published and obtain their consent. In principle, the paper will be published within one year.

3. Copyright Matters

(1) In order to maintain academic ethics, please do not submit manuscripts to other journals while they are under review by the editors. In case of plagiarism, adapting from pre-existing work, and other copyright infringement, the author shall bear the relevant legal responsibilities.

(2) The authorization method of this journal is a Non-exclusive License to the publishing unit. Once it is decided that the manuscript will be published, it is necessary to sign the authorization of the right to publish articles within the time limit and return the authorization to the editorial department by registered mail.

4. Review of Manuscripts

(1) All manuscripts in this journal are subject to a two-way anonymous internal and external review processes. The editorial board of the journal invites two scholars and experts in related fields to review manuscripts. The article, after being reviewed by the review committee, is a revised article, and the editorial

board will decide whether to publish it after revisions have been completed by the author.

(2) All manuscripts accepted for publication in this journal may be selected for publication upon the approval of the editorial board and depending on the needs of the editors.

審稿辦法

2005.1.18 編輯委員會會議通過
2006.4.17 編輯委員會會議通過
2010.2.8 編輯委員會議修正通過
2011.2.10 編輯委員會議修正通過
2012.8.16 編輯委員會議修正通過
2014.8.25 編輯會議修正通過
2018.9.28 編輯會議修正通過
2019.12.9 編輯會議修正通過
2024.3.13 編輯會議修正通過

壹、審稿流程

本刊之審查包括預審、初審、複審。

一、預審

主編就來稿之性質、格式、體例及嚴謹程度進行審查。

二、初審

（一）通過預審之文章由編輯會聘請兩位審查人進行匿名審查。

（二）初審意見分為四類：

1. 通過、2. 修正後通過、3. 修正後需經審稿者複審、4. 不通過。審查結果為「通過」或「建議修正後通過」者列為候選刊登名單，並提經編輯會議決刊登。

（三）若兩位審查人意見相差過大時，且其中一位意見為「通過」或「建議修正後通過」意見者，應送第三位審查人審查，本刊將依據第三位審查人之意見決定是否刊登。

（四）兩位審查人意見為「修正後需經審稿者複審」及「不通過」者，予以退稿。

三、複審

（一）若審查人建議為「修正後通過」及「修正後需經審稿者複審」之文章，本刊將請作者修改，作者須於二周內寄回，並隨文附上「修改、答辯相關說明」，本刊將把修改之稿件及此說明文件交由主編或原審查人進行複審；本刊將根據複審意見提經編輯會議決刊登。

（二）所有通過複審之論文列為候選名單，並交由編輯會討論收錄之期數。

四、審查迴避

（一）本刊之編輯會成員及國家教育研究院現職人員以作者身分投稿，不得參與審稿流程（預審、初審及複審）。

（二）本刊當期主編以作者身分投稿，由發行人指定代理人進行預審。
（三）投稿作者未經編輯會主席同意，不得參與擬收錄文稿之討論事項。
（四）編輯會聘請審查人時，應考量專長之符合性及研究表現優良者，宜避免審查人與作者有下列關係：
1. 近三年曾任職同一系、所、科或單位。
2. 近三年曾有指導博士、碩士論文之師生關係。
（五）已獲聘請之審查人，如自行發現與該文作者有以下利害關係、宜予迴避，請速與本刊編輯人員聯絡：
1. 近二年發表論文或研究成果之共同作者。
2. 審查論文時有共同執行研究計畫。
3. 配偶或三親等以內之血親或姻親。
4. 與該文有利益衝突之可能。
（六）審查迴避事項如有疑義，由編輯會議決。

五、其他事項
（一）「審查迴避名單」可由作者提出 2 ～ 3 名作為主編預審推薦參考。
（二）同一作者（包含共同作者），其作品以一年刊登一次為原則；特殊情況則於編輯會上提案討論。
（三）於正式出版前：
1. 如發現違反學術倫理情況，由編輯會召開會議共同商議處理方式。
2. 如論文存有限期內無法改善之問題，授權由該期主編決定處理方式。
（四）為確保作者權益，編輯部聯絡審查人時明確告知：審查回件期限以一個月回函為原則；若回件時間逾一周以上，即報告主編並另行推薦審查人。
（五）同一文稿，退稿後半年內不宜連續投稿。

貳、稿件刊登

經審查為「通過」、「修正後通過」及經評審為「修正後需經審查者複審」後經原審查人複審通過之稿件，將提請編輯會進行刊登確認，通過後本刊將寄發「接受刊登證明」及「出版同意授權書」，以利文章刊登出版。

參、撤稿作業原則

一、作者應以書面掛號方式，提出撤稿申請。
二、對凡已進入初審階段之稿件，若作者提出撤稿申請，本刊一年內不接受投稿。

Paper Review Regulations

Approved on January 18, 2005 by the Editorial Committee Meeting.
Approved on April 17, 2006 by the Editorial Committee Meeting.
Revised and approved on February 8, 2010 by the Editorial Committee Meeting.
Revised and approved on February 10, 2011by the Editorial Committee Meeting.
Revised and approved on August 16, 2012 by the Editorial Committee Meeting.
Revised and approved on August 25, 2014 by the Editorial Committee Meeting.
Revised and approved on September 28, 2018 by the Editorial Committee Meeting.
Revised and approved on December 9, 2019 by the Editorial Committee Meeting.
Revised and approved on March 13, 2024 by the Editorial Committee Meeting.

I. Review process

The review process of this publication includes pre-review, preliminary review, and secondary review.

1. Pre-review

   The editor-in-chief shall review the nature, format, style, and rigor of the manuscript.

2. Preliminary review

   (1) Articles that have passed the pre-review shall be anonymously reviewed by two reviewers appointed by the editorial board.

   (2) The preliminary review opinions are divided into four categories: (1) Pass; (2) Pass after the recommended revision; (3) Secondary review by the reviewers after revision; and (4) Fail. Those who receive a "Pass" or "Pass after the recommended revision" shall be listed as candidates for publication, and their articles shall be submitted to the Editorial Committee Meeting for resolution on publication.

   (3) If the opinions of the two reviewers differ too greatly, and one of the opinions is a "Pass" or "Pass after the recommended revision ", the article shall be submitted to a third reviewer for review. The journal shall rely on the opinion of the third reviewer on whether the article should be published.

   (4) If the opinions of the two reviewers are "Secondary review by the reviewers after revision" and "Fail", the manuscript shall be rejected.

3. Secondary review.

   (1) If reviewers recommend that an article be "Passed after revision" or undergo a "Secondary review by the reviewers after revision", the journal shall request

the author to revise the article. The author shall respond within two weeks with a "revision and relevant explanations" of the manuscript. The journal shall submit the revised manuscript and explanation to the editor-in-chief or the original reviewers for a secondary review. The journal shall submit the secondary review opinions to the Editorial Committee Meeting for resolution on publication.

(2) All papers that have passed the review shall be shortlisted and submitted to the Editorial Committee Meeting for discussion on the issue number to be accepted into. All papers that have passed the review shall be shortlisted and submitted to the Editorial Committee Meeting for acceptance discussion.

4. Recusal from review

(1) Members of the Editorial Committee of this journal and the current staff of the National Academy for Educational Research who submit a manuscript as an author shall not participate in its review process (pre-review, preliminary review, and secondary review).

(2) If the current editor-in-chief of the journal submits a manuscript as an author, the publisher shall designate an agent to conduct the pre-review.

(3) Unless otherwise approved by the chair of the Editorial Committee, contributing authors shall not participate in the discussion of the submitted manuscripts.

(4) When appointing reviewers, the Editorial Committee shall take into consideration the expertise and research performance of the reviewers. Reviewers with the following relationship with the author shall be avoided:

1. Worked in the same department, institute, division, or unit in the past three years.
2. Had a teacher-student relationship in the capacity of a doctoral or master's thesis advisor in the past three years.

(5) If an appointed reviewer finds that he or she has the following stakeholder relationship with the author of the article, he or she shall withdraw from the review and contact the editor of this journal as soon as possible:

1. Co-authored papers or research results published in the past two years.
2. Co-implementers of a research project during the review.
3. Spouse or relative by blood or marriage within the third degree of kinship.
4. A potential conflict of interest with the article being reviewed.

(6) In case of any doubt about recusal from the review, the determination shall be made by the Editorial Committee.

5. Other matters
   (1) Authors may submit 2 to 3 names for the "Review Recusal List" to the editor-in-chief as reference for the pre-review.
   (2) Works by the same author (including co-authors) shall generally be works that are published once a year; special cases shall be referred to the Editorial Committee for discussion.
   (3) Before official publication:
      1. If a violation of academic ethics is found, the Editorial Committee shall convene a meeting to discuss the method of handling.
      2. If a paper cannot be improved within the deadline, the editor-in-chief for the issue of the journal shall have the authority to determine the method of handling.
   (4) To ensure the rights and interests of the authors, the Editorial Department shall clearly inform the reviewers of the following upon contacting them: Review of papers shall generally be completed within one month. If the response is overdue by more than one week, the reviewer shall notify the editor-in-chief and recommend another reviewer.
   (5) After being rejected, the same manuscript shall not be re-submitted within half a year.

II. Manuscript publication

Manuscripts that have received a "Pass" or "Pass after revision", or manuscripts that have received a "Secondary review by the reviewers after revision" and subsequently passed by the original reviewers shall be submitted to the Editorial Committee to confirm publication. Manuscripts confirmed for publication shall be issued a "Certificate of Acceptance for Publication" and " Authorization and Consent to Publication" to facilitate the publication of the articles.

III.Principles for withdrawing manuscript

1. To withdraw his or her manuscript, author shall submit a written application for withdrawal.
2. If an author applies to withdraw his or her manuscript that has entered the preliminary review stage, the journal shall not accept his or her subsequent manuscript submission within one year.

《教育研究與發展期刊》投稿者基本資料表

Journal of Educational Research and Development
Submission Form

姓名 Author（s）	中文： 英文：	投稿日期 Submission date	
投稿篇名 Title	中文： 英文：		
擬投稿之領域 Category of submission	☐ 師資培育與教師專業發展（Teacher Education and Empowerment） ☐ 課程與教學（Curriculum and Instruction） ☐ 教育政策與制度（Educational Policy and Administration） ☐ 教育心理、輔導與測評（Testing and Assessment）		
稿件字數 Word count	全文共 _____ 字（含中英文摘要、正文、參考書目、附錄、圖表等） (Abstract, text, references, appendixes, tables are included)		
服務單位及職稱 Affiliation & Position			
最高學歷 Highest Degree			
專長領域 Specialization			
通訊地址 Address			
聯絡電話 Telephone	（O） （H） （M）		
電子郵件 E-Mail			
其他說明事項：			

國家教育研究院期刊雜誌著作利用授權書

本院 102 年 8 月 13 日第 58 次院務會報修正通過
本院 110 年 11 月 30 日第 158 次院務會報修正通過

作者（即撰稿人）於《教育研究與發展期刊》所發表之

論　　文：＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿，

同意下列所載事項：

一、作者擔保對本著作有授權利用之權利，並擔保本著作並無不法侵害他人著作權或其他權利之情事；本著作如屬研究計畫成果加以改寫者，也已依所屬機關學校規範取得發表權利。

二、作者同意全部內容無償授權國家教育研究院作無期限、地域、方式、性質、次數等限制之利用，國家教育研究院並得再授權第三人利用，本授權非專屬授權。

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