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澳大新語 UMagazine

工程與AI的結合

The Integration of Engineering and AI

Spring/Summer 2025 | Issue 31

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總編輯: 張惠琴博士
編輯: 郭麗雅、樊越欣
翻譯: 謝菀菁、關詠琪
排版: 何杰平

顧問:
人文學院副院長、翻譯傳譯認知研究中心主任
李德鳳特聘教授
人文學院藝術設計中心主任
梁藍波特聘教授
社會科學學院傳播系副教授
Timothy Simpson
人文學院中國語言文學系榮休教授
鄧景濱

地址: 中國澳門氹仔大學大馬路
澳門大學行政樓(N6) G012室

電話: (853) 8822 8833
傳真: (853) 8822 8822
電郵: prs.publication@um.edu.mo

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Chief Editor: Dr Katrina Cheong
Editors: Gloria Kuok, Gigi Fan
Translators: Bess Che, Winky Kuan
Designer: Jack Ho

Advisors:
Li Defeng, Associate Dean, Faculty of Arts and Humanities / Distinguished Professor and Director, Centre for Studies of Translation, Interpreting and Cognition
Lampo Leong, Distinguished Professor and Director, Centre for Arts and Design, Faculty of Arts and Humanities
Timothy Simpson, Associate Professor, Department of Communication, Faculty of Social Sciences
Tang Keng Pan, Emeritus Professor, Department of Chinese Language and Literature, Faculty of Arts and Humanities

Address: Room G012, Administration Building (N6), University of Macau, Avenida da Universidade, Taipa, Macau, China

Tel: (853) 8822 8833
Fax: (853) 8822 8822
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編者的話
EDITOR'S WORDS

在科技浪潮洶湧澎湃、教育理念不斷革新的當下，教育與科研的融合成為推動社會進步的關鍵力量。今期《澳大新語》的「封面專題」圍繞工程教育與人工智能的融合，著眼於澳大工程教育的全方位創新，以行業需求為導向，重塑教學體系，為學生開啟通往智能工程時代的大門。

「專題探討」欄目探尋澳大與葡萄牙知名高校近年在學術交流、學生交換、科研合作等方面的豐碩成果，展現國際合作對教育科研的推動作用。另一篇文章則聚焦澳大在消炎領域的自主研發項目，為攻克炎症相關難題帶來新希望。

本期的「人物專訪」對話教育學院講座教授、教育測驗與評核研究中心主任柳秀峰，聽其分享逾30載的教育研究經歷，運用科學測量方法以提升科學教育的質量；此外，我們跟隨協同創新研究院認知與腦科學研究中心副教授Michiel Spapé的步伐，走進人機共生這一前沿研究領域，解碼人類意識與機器智能融合的奧秘。

「學術研究」帶來多元研究成果。澳大學者圍繞利用fNIRS超掃描技術探索兒童大腦同步化、智慧城市建設的跨學科協同路徑，以及藝術與科學的獨特交集等多元話題展開深入探討。刊末的「書院發展」欄目，帶領讀者走進何鴻燊東亞書院，領略其如何營造溫馨家園氛圍，以學術與實踐雙輪驅動，助力學生全面成長。

希望本期《澳大新語》能讓讀者深入了解澳大在學術研究、教育創新以及國際合作等方面的發展情況，感受澳大師生勇於探索、敢於創新的精神風貌。

張惠琴博士 Dr Katrina Cheong

In a rapidly changing world shaped by technological advancements and evolving educational philosophies, combining education and research creates a pivotal force to drive social progress. In this issue of *UMagazine*, our Cover Story section focuses on the confluence of engineering education and artificial intelligence at the University of Macau (UM). By reinventing engineering education with innovative, industry-focused approaches, the university equips students with the knowledge and skills needed to thrive in the intelligent era.

In the Topic Insight section, we look at UM's strong partnerships with leading Portuguese universities in recent years. These collaborations, which include academic and student exchanges as well as joint research projects, demonstrate how international collaboration plays a key role in advancing education and research. Another article spotlights UM's groundbreaking research in anti-inflammatory therapies, which offers new hope for treating inflammation-related diseases.

We also had the opportunity to interview Prof Liu Xiufeng, chair professor in the Faculty of Education and director of the Educational Testing and Assessment Research Centre. He reflects on his 30 years of work in education research and explains how scientific measurement can enhance the quality of science education. In addition, Prof Michiel Spapé, associate professor in the Centre for Cognitive and Brain Sciences under the Institute of Collaborative Innovation, shares insights about the cutting-edge field of human-machine symbiosis. His research, which combines artificial intelligence with the study of human consciousness, is enhancing understanding of how machines and humans can work together.

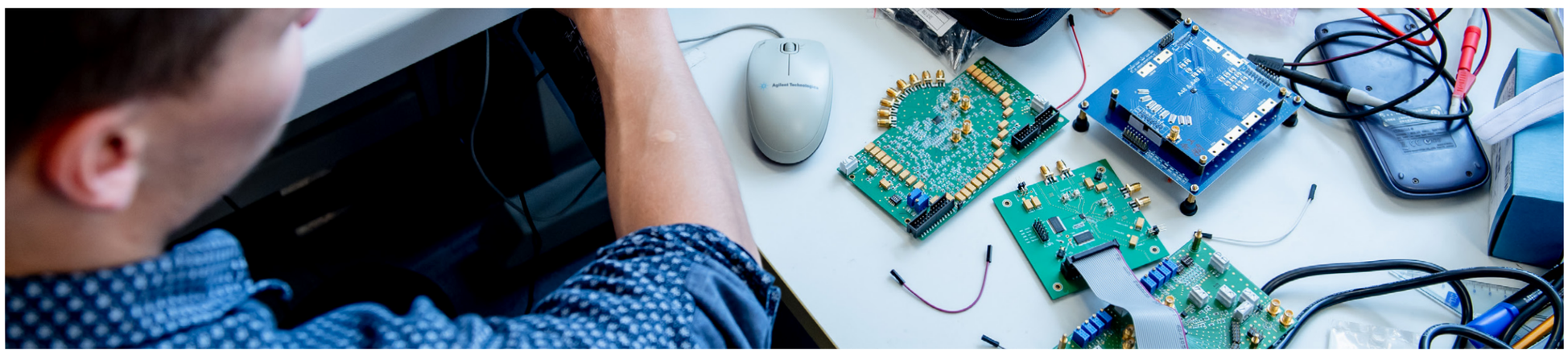
The Academic Research section highlights the diversity of UM's research excellence, from investigating synchronisation in children's brains using fNIRS hyperscanning to fostering interdisciplinary collaboration for smart city development, alongside a unique dialogue between art and science. Lastly, the RC Development section invites readers to explore the development of Stanley Ho East Asia College into a supportive home utilising various educational initiatives and experiential learning activities that support students' holistic development.

We hope this issue of *UMagazine* offers readers deeper insights into UM's research progress, educational innovation, and international collaboration. Meanwhile, we continue to showcase the adventurous and innovative spirit of the UM community.

目錄

CONTENTS

2025年 春/夏 | 總第31期
Spring / Summer 2025 | Issue 31



工程與AI的結合：澳大工程教育的創新

Integrating Engineering and AI: UM's Innovative Engineering Education

文：樊越欣｜圖：何杰平、部分由受訪者提供｜英文翻譯：謝菀菁
Text: Gigi Fan｜Photo: Jack Ho, with some provided by the interviewees｜English Translation: Bess Che

當科技強國提出5.0工業革命，當大數據、物聯網等新興技術與產業深度融合，當人工智能以迅雷不及掩耳之勢席捲全球，我們身處的世界，正經歷著瞬息萬變的科技浪潮和產業革命，這既對科技及工程教育提出挑戰，亦提供難得的發展機遇。為此，澳大的工程教育正在積極變革，以跨學科驅動課程創新，深度探索工程與人工智能的融合路徑，打造緊扣業界需求的課程體系，致力為粵港澳大灣區，尤其是澳門及橫琴合作區的產業轉型升級，輸送適應時代發展的高素質工程專業人才，為區域發展注入新動力。

多元的工程教育體系

澳大工程教育涵蓋土木及環境工程系、電機及電腦工程系、機電工程系等多個學系。各學系均設有本、碩、博學位課程，本科階段著重為學生奠定堅實的工程學專業基礎；研究生階段，開設土木工程、建造項目管理、電機及電腦工程、機器人與自主系統、機電工程等理學碩士學位項目，注重培養學生的專業深度與實踐能力。

推進人工智能融入課程

面對新興技術的衝擊，澳大工程教育體系正在創新與優化，跨學科合作成為課程改革的亮點之一。科技學院為開設工程教育的學術單位，在工程相關的教學內容方面，不斷強化數字化、資訊化、智能化等元素，將融入人工智能概念及應用的課程於各年級分層設置，滿足不同背景、不同程度學生的多樣化學習需求。各工科學系都在積極探索，在課程設計中融入人工智能、數據科學元素。

以土木工程為例，鑑於基於數位孿生的智慧建築技術在土木工程領域應用廣泛，及時開設理學碩士學位（建造項目管理）課程。學生通過學習，能運用人工智能算法進行項目進度預測、資源調配優化，提升在工程建設全生命周期的管理能力；機電工程專業則探索智能製造、機器人應用的新方向，利用人工智能實現設備故障診斷和預測性維護。

為順應科技發展趨勢，微電子系、人工智能系、機器人系正在計劃籌建中，持續拓展工程教育與新興技術融合的深度與廣度。

分層培養注重實踐的專業人才

澳大的工程教育始終將育人目標緊扣產業需求。要求學生具備紮實的科學素養、創新精神以及動手實踐能力，成為全體工程學子的必備素養。

「要成為卓越工程人才，必須科學素養和工程能力融合、創新性和批判性思維並重。」科技學院院長須成忠教授在談到工程學的育人要求時指出，尤其需要注重學生動手能力培養。在課程設計與教學安排中，為學生提供大量將理論知識應用於實際場景的機會，通過各類實驗課程及實踐項目，如組織本科生參與基於人工智能的小型工程項目，切實提升解決實際問題的能力。

對於碩士研究生培養，須教授分享做法，「我們從學生招募到入學，從課程到實驗，從實習到就業升學，提供全流程的服務。」入學時舉辦迎新儀式，幫助學生快速融入，增強歸屬感；高達52.4%的碩士研究生以獎學金、擔任教學助理、研究助理等多種方式獲得資助，得以專注學習。每門研究生課程的核心科目均設有實驗部分，並打造示範性實驗室（Showcase Laboratory），搭建將核心理論知識應用於實踐的平台。學院還舉辦行業研討會系列講座，讓學生聆聽業界代表講解真實案例，深入了解行業動態。學生可選擇以項目報告或實習作為兩年制碩士課程的畢業考核方式，取代傳統單一的研究論文模式，進一步鍛煉實踐能力與創新思維能力。

國際化交流與合作

推動國際學術交流及科研合作是澳大的特色，在科技學院的統籌下，澳大的工程學科與多間國外大學建立聯合培養計劃，如與里斯本大學合辦「2+2」雙博士學位、與倫敦帝國理工學院等合作「1+3」碩博課程等。同時為學生提供到國外大學短期進修、參與全球學術論壇，及邀請全球優秀學者到澳大訪問交流的機會，促進國際學術交流，拓寬國際視野。

須教授指出，近年大量畢業於世界名校的年輕教師紛紛加入學院，目前逾八成教職員畢業於世界知名大學，帶來優質的教學和豐富的研究經驗，推動教學、研究成果顯著，過去12年，學院發表的學術論文數量增長了兩倍，進入SCI Q1和Q2的文章高達85.7%，彰顯學院的科研實力。在泰晤士高等教育（THE）2025年公佈的世界科目排名中，學院的工程學位列世界126名；工程學進入基本科學指標資料庫（ESI）前1%之列。

學生升學及就業情況理想

工程專業畢業生的升學及就業情況理想，不少繼續深造的畢業生獲倫敦帝國理工學院、愛丁堡大學、香港大學、墨爾本大學、南加州大學及新加坡國立大學等頂尖大學取錄。

就業方面，科技學院與格力、南光、廣汽等60多間企業和政府部門緊密合作，為每位學生提供寶貴的實習機

須成忠教授
Prof Xu Cheng-Zhong

科技學院2025年首次舉辦「橫琴合作區和大灣區科技及工程就業實習雙選會」

FST held the first UM FST GBA T&E Career and Internship Fair in the Cooperation Zone in Hengqin in 2025

會，也為企業物識及網羅合適的專業人才創造條件。今年3月，學院首次舉辦「橫琴合作區和大灣區科技及工程就業實習雙選會」，吸引近30間大灣區企業提供近1,000個科技與工程相關職位，助力學生在就業市場脫穎而出。須教授透露，學院近半博士畢業後在高校任教，而碩士畢業生的平均月薪達到人民幣23,000元，力證學院的育人成效與學生的市場競爭力。

值得一提的是，根據澳門特區政府訂定的建築及城市規劃範疇的認證註冊制度，具有包括土木工程學、環境工程學、電機工程學、機電工程學等專業範疇學位在內的人士，通過實習及考試後可登記成為工程師。據統計，澳門近80%的機電工程師、50%電機工程師及25%的土木工程師自澳大畢業。

以工程教育推動澳琴產業升級

在科技發展的征程中，澳大正穩步前行，始終以產業需求為導向，不斷優化工程教育教學體系，推動工程與人工智能的深度融合，加強師資隊伍建設，深化產學研合作，為學生提供更優質的教育資源與實踐機會，為澳門經濟適度多元及橫琴合作區的產業發展輸送更多高素質專業人才。

As technological powerhouses lead the charge into Industrial Revolution 5.0—where big data models, the Internet of Things, and artificial intelligence are rapidly transforming industry—a wave of profound change is reshaping our world. This transformation presents both significant challenges and exciting opportunities for science, technology, and engineering education. In response, the University of Macau (UM) is reinventing engineering education. By fostering interdisciplinary curriculum innovation and integrating artificial intelligence into courses, UM is aligning its engineering programmes with the evolving demands of industry. The university is committed to developing high-quality engineering professionals equipped to meet the challenges of the new era. Through these efforts, UM aims to contribute to the industrial transformation of the Guangdong-Hong Kong-Macao Greater Bay Area, particularly Macao and the Guangdong-Macao In-depth Cooperation Zone in Hengqin, and to inject new momentum into regional development.

Diverse Engineering Education System

UM's engineering education is structured across several departments, including the Department of Civil and Environmental Engineering, Department of Electrical and Computer Engineering, and Department of Electromechanical Engineering. These departments offer a full range of degree programmes, from undergraduate to doctoral levels. The undergraduate programmes are designed to provide students with a strong foundation in engineering, while the postgraduate programmes focus on deepening professional knowledge and practical skills. Master of Science (MSc) programmes are available in the fields of civil engineering, construction project management, electrical and computer engineering, robotics and autonomous systems, and electromechanical engineering.

Integrating AI into Curricula

In response to rapid advancements in emerging technologies, UM is enhancing its engineering education system, with interdisciplinary collaboration as a key strategy. The Faculty of Science and Technology (FST), which leads UM's engineering education, enriches programme curricula by placing greater emphasis on digitisation, informatisation, and intelligentisation. AI integration and practical AI applications are also systematically incorporated into courses at all levels. These efforts ensure that the educational offerings meet the diverse learning needs and proficiency levels of students. Moreover, all engineering departments are exploring ways to integrate AI and data science into curricula.

In civil engineering, for example, FST has launched an MSc programme in construction project management in response to the increasing use of digital twin-based smart construction technologies. This programme equips students with the skills to apply AI algorithms for project schedule prediction and resource allocation optimisation, enabling them to manage engineering projects effectively throughout their lifecycle. Similarly, the MSc programme in electromechanical engineering focuses on smart manufacturing and robotics, leveraging AI to improve equipment fault diagnosis and predictive maintenance.

To stay at the forefront of technological advancements, FST is also planning to establish new departments in microelectronics, artificial intelligence, and robotics. The faculty is committed to deepening the integration of engineering education and cutting-edge technologies.

澳大推進人工智能融入工程專業課程

UM integrates artificial intelligence into its engineering programmes

Building Professional Knowledge and Practical Skills Through Progressive Training

UM's engineering education is closely aligned with industry needs. The university emphasises the development of strong scientific literacy, an innovative spirit, and hands-on practical skills—essential qualities for every engineering student.

'To nurture students into exceptional engineering professionals, we must develop their ability to integrate scientific knowledge and engineering expertise, while fostering their innovative and critical thinking,' emphasises FST Dean Prof Xu Cheng-Zhong as he discusses the essentials of engineering education. He highlights the importance of developing students' practical skills, a focus that is deeply embedded in UM's engineering education system. All courses and learning activities are designed to provide students with ample opportunities to apply theoretical knowledge in real-world scenarios. Through various laboratory courses and hands-on projects, such as engaging undergraduates in AI-based mini-engineering projects, students significantly enhance their problem-solving skills.

Prof Xu also shares the design of postgraduate engineering programmes: 'From student recruitment and enrolment to coursework, lab work, internship, and career planning, we offer comprehensive support at every step.' To help new students adapt to university life and build a sense of belonging, FST organises orientation activities at the start of each semester. Additionally, financial support is widely available—52.4 per cent of master's students receive scholarships, teaching assistantships, or research assistantships—ensuring that students can focus on their academic studies. A strong emphasis is placed on hands-on learning, with laboratory components integrated into the core courses of every postgraduate engineering programme. A standout feature is the Showcase Laboratory, which provides students with a platform to apply theoretical knowledge to real-world situations. To deepen students' understanding of industry practices, the faculty regularly hosts industry seminar series. These events allow students to learn from professionals who share real-world case studies and discuss emerging trends. The two-year master's programmes also offer flexibility in graduation requirements, enabling students to choose between a project report or an internship instead of a thesis. This innovative approach is designed to enhance students' practical skills while fostering their ability to think creatively and solve real-world problems.

International Exchange and Collaboration

UM attaches importance to promoting international academic exchange and research collaboration. Under the coordination of FST, UM has established several joint training programmes in engineering with overseas universities. These include a '2+2' dual PhD degree programme with the University of Lisbon and '1+3' master's-PhD programmes in collaboration with institutions such as Imperial College London. In addition, UM provides students with opportunities to attend short-term courses abroad, participate in international academic forums, and engage with renowned scholars from around the world. These initiatives not only foster international academic exchange, but also broaden students' international horizons.

Prof Xu notes that in recent years, a growing number of graduates from world-renowned universities have joined FST. Currently, over 80 per cent of FST's academic staff hold degrees from prestigious international institutions. These faculty members bring exceptional teaching expertise and extensive research experience, driving significant progress in both teaching and research. Over the past 12 years, the number of academic papers published by FST has tripled, with 85.7 per cent of them appearing in SCI Q1 and Q2 journals, reflecting the faculty's strong research capabilities. In the Times Higher Education (THE) World University Rankings by Subject 2025, UM's engineering programmes were ranked 126th globally. Additionally, the university's engineering discipline is ranked among the top one per cent in the Essential Science Indicators (ESI) database.

Empowering Students for Success in Advanced Studies and the Job Market

UM's engineering graduates excel in both advanced academic pursuits and professional careers. Many who choose to pursue further education gain admission to prestigious universities, such as Imperial College London, the University of Edinburgh, the University of Hong Kong, the University of Melbourne, the University of Southern California, and the National University of Singapore.

On the employment front, FST has established strong partnerships with over 60 enterprises, including Gree Electric, Nam Kwong Group, and GAC Group, as well as various government departments. These partnerships provide students with valuable internship opportunities while enabling employers to recruit highly qualified professionals. In March this year, FST organised the first UM FST GBA T&E Career and Internship Fair in the Cooperation Zone in Hengqin. Nearly 30 companies from the Greater Bay Area participated, offering about 1,000 job opportunities in technology and engineering. The fair significantly boosted students' competitiveness in the job market. According to Prof Xu, nearly half of FST's doctoral graduates secure academic positions at higher education institutions after graduation, while master's graduates earn an average monthly starting salary of RMB 23,000. These achievements underscore the high quality of FST's education and the strong competitiveness of its graduates in the market.

It is worth noting that under the certification and registration system for architecture and urban planning professionals established by the Macao SAR Government, individuals with a degree in civil engineering, environmental engineering, electrical engineering, or electromechanical engineering can become registered engineers after completing internships and passing the required examinations. Notably, UM graduates constitute about 80 per cent of Macao's electromechanical engineers, 50 per cent of its electrical engineers, and 25 per cent of its civil engineers.

Driving Industry Development in Macao and Hengqin

Amid rapid technological advancements, UM remains steadfast in its commitment to an industry-oriented approach in engineering education. The university continuously refines its education system, fosters deeper integration of engineering and artificial intelligence, strengthens faculty development, and enhances industry-academia collaboration. These initiatives aim to provide students with exceptional educational resources and practical opportunities, while cultivating high-quality professionals to support Macao's economic diversification and the industrial development in the Cooperation Zone in Hengqin.

師生們參觀鋼結構預製組件製作廠房

Teachers and students visit the steel prefabricated components manufacturing plant

土木工程教育在時代變革中的角色

Civil Engineering Education in an Era of Transformation

文：樊越欣｜圖：何杰平、部分由受訪者提供｜英文翻譯：郭麗雅、謝菀菁
Text: Gigi Fan | Photo: Jack Ho, with some provided by the interviewees | English Translation: Gloria Kuok, Bess Che

土木工程（Civil Engineering）中的「Civil」，源自「Civilisation（文明）」的詞根，從城市基建、交通運輸、環境工程到智能建造，土木工程是社會發展的重要基石，土木工程師是人類生存環境的塑造者、是人類文明的堅實鋪路人。在時代的滾滾浪潮中，土木工程領域正經歷深刻變革，對人才提出新考驗。澳大土木工程教育正緊扣趨勢，貼合智能化行業需求，持續革新，培養契合時代發展的卓越土木工程人才。

深度融合業界的協同育人模式

土木工程是一門實踐性極強的科學。澳大的土木及環境工程學士學位課程框架參照葡萄牙工程教育體系搭建，此後歷經革新，成功通過香港工程師學會認證。一直跟進評鑑工作的土木及環境工程系主任周萬歡教授指出，該系在港澳地區較早採用「成果導向教育」（outcome-based education）的教育理念，著重培養學生紮實的工科基礎和解決實際問題的能力。

為讓學生緊貼行業需求，該系構建全過程式的實踐教學體系：課堂中融入實際案例、邀請業界分享，讓學生真切明白項目的實際難點和解決方案。同時，為學生搭建先進的實驗平台，如大氣污染實時監測系統、土木工程虛擬實境與擴增實境強化之施工安全訓練平台等，鼓勵他們動手操作，深化理解。

學生有眾多「走出去」與業界交流的機會，包括參加行業講座、參訪企業等。因院系與本地和大灣區的知名建築公司、結構設計院、政府基礎設施的施工單位建立長期合作關係，讓學生獲得充足的實習機會。

本科四年級學生秦梓超不掩飾對工地現場施工管理工作的興趣，源於他在中國路橋工程有限責任公司（港澳地區）的一段實習經歷。他主要負責水泥灌注樁施工，還參與施工監測、技術數據記錄及分析、協助工程師檢查及驗收施工質量等多項工作。「實習讓我對實際施工有了深刻理解，親睹灌注樁的施工工藝、質量控制標準技術的應用，令我對未來職業規劃有了新思考。」

前沿技術驅動的課程創新

當下，土木工程行業正在被新興技術重塑，諸如人工智能、大數據、物聯網等前沿科技，已深度滲透到項目的規劃、設計、施工及運維各環節。周萬歡教授深信，「未來的土木工程師，不僅要掌握傳統技能，更要利用新興技術提升工程效率及安全性。」土木工程教育必須緊跟趨勢，革新教學內容。

在課程設置上，澳大密切關注行業動態及規範標準，及時將新內容納入土木工程教學中。如將人工智能、大數據等技術，應用於岩土工程數值分析、交通工程資料分析、結構分析、優化計算、智慧監測以及預測建模等學科上，提升學生對前沿技術工具的掌控力。

該系本科生吳煥淋甫畢業即獲世界知名企業奧雅納工程顧問（澳門分公司）聘用，有感工作需要，遂回母校攻讀碩士學位。她直言選擇正確，岩土工程領域正經歷快速發展，澳大在新技術應用領域也與時俱進，貼合行業需求。且具工作經驗後，她對課程內容的應用場景有更深刻的理解，「有一次，上司白天向我解釋如何從土壤測試結果獲得某項土壤參數，當天晚上教授又講解同一概念。這不僅讓學習更加高效，也幫助我工作時從更嚴謹的角度分析問題，相得益彰。」

The word ‘civil’ in ‘civil engineering’ comes from the Latin word ‘civilis’, meaning ‘relating to citizens’. It is also the root of the word ‘civilisation’. From urban infrastructure and transport systems to environmental engineering and intelligent construction, civil engineering is the backbone of social development. Civil engineers shape the world we live in and construct the foundation of human civilisation. As the world rapidly changes, civil engineering evolves as well, bringing new challenges for professionals in the field. To keep up with these advancements, the University of Macau (UM) has reinvented civil engineering education to align with the industry’s growing focus on smart technologies. Through continuous innovation, the university is committed to cultivating exceptional engineers equipped to lead in the new era.

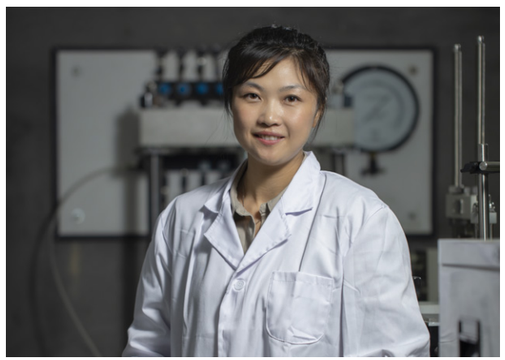
以賽促學具成效

周教授認為，土木工程是一門系統科學，因此學生的綜合能力很重要，自主學習、團隊協作、創新思維及解決實際問題的能力不可或缺，支持他們參與學科競賽是鍛鍊這些能力的不二之舉。近三年，該系學生在全國大學生橋樑設計競賽、全國大學生結構設計信息技術大賽等多項高水平賽事中取得佳績，部分為粵港澳大灣區高校中最佳或唯一得獎，更有學生自此加入導師的科研團隊，延續科研興趣。

就業出路廣闊

周教授指出，「土木工程是支撐社會發展的基石，無論行業如何變革，我們的畢業生始終能在全球範圍內找到符合自身發展的機會。」事實上，澳大畢業生在澳門土木工程行業內的認可度頗高，近半本科畢業生進入工程公司，從事基礎設施建設、建築設計、結構分析等工作，近三年畢業的碩士研究生更是百分百就業，學生畢業後赴香港甚至海外工作的機會也不少。此外，每年約五成本科畢業生選擇升學深造，不少獲新加坡國立大學、香港大學、香港科技大學、悉尼大學、瑞典皇家理工學院等錄取。

「儘管行業存在周期性變化，但土木工程不會消失，而是不斷演進，我們要做的是跟上時代的步伐，讓學生具備更強的競爭力。」澳大的土木工程教育始終秉持服務社會、推動行業發展的宗旨，致力於培養真正優秀的工程師、永遠會在行業變革中找到屬於自己機會的土木工程專業人才。



周萬歡教授
Prof Zhou Wanhuan

Industry-Oriented Education Model

Civil engineering is a hands-on discipline. UM's bachelor's degree programme in civil engineering was originally designed according to the engineering education system in Portugal. After subsequent reforms, the programme earned accreditation from the Hong Kong Institution of Engineers. Prof Zhou Wanhuan, head of the UM Department of Civil and Environmental Engineering, is responsible for programme evaluation. She notes that the department was one of the first in Hong Kong and Macao to adopt outcome-based education. This approach emphasises building a strong engineering foundation for students and enhancing their practical problem-solving skills.

To ensure students stay aligned with industry needs, the department has developed a comprehensive practice-oriented education system. For example, real-world case studies are incorporated into the curriculum, and industry professionals are invited to share their insights to help students better understand practical challenges and solutions in real-world projects. The department also provides advanced experimental platforms, including a real-time air pollution monitoring system and a civil engineering VR and AR enhanced training platform for construction safety training, enabling students to gain hands-on practice and deepen their understanding.

In addition, the department offers students extensive industry exposure by organising seminars and visits to enterprises. Furthermore, the department's long-term partnerships with leading construction firms, structural design institutes, and infrastructure construction agencies in Macao and the Greater Bay Area provide students with numerous internship opportunities.

吳煥淋
Ung Wun Lam

秦梓超
Qin Zichao

Thanks to his internship at China Road and Bridge Corporation (Hong Kong and Macao), Qin Zichao, a fourth-year student, discovered his passion for on-site construction management. During the internship, he was mainly responsible for cast-in-place pile construction. He also participated in construction monitoring, technical data recording and analysis, as well as assisting engineers in quality inspections and construction approvals. Reflecting on the experience, Qin says, 'The internship gave me a deep understanding of real-world construction practices. Seeing the construction techniques and quality control standards for cast-in-place piles on site has reshaped how I think about my future career.'

Fostering Programme Innovation Through Cutting-Edge Technologies

With rapid technological advancements, emerging technologies such as artificial intelligence, big data models, and the Internet of Things are reshaping the civil engineering industry. These technologies are now integrated into every stage of a project, from planning and design to construction and maintenance. Prof Zhou says, 'Future civil engineers are required to not only master traditional skills, but also leverage new technologies to enhance engineering efficiency and safety.' As a result, it is necessary for civil engineering education to keep pace with these developments and continuously update its curriculum.

UM pays close attention to industry developments, regulations and standards to ensure its civil engineering curriculum stays up to date. For example, artificial intelligence and big data applications are incorporated into various courses, including numerical analysis in geotechnical engineering, data analysis in traffic engineering, structural analysis, optimisation algorithms, smart monitoring, and predictive modelling, so as to equip students with the skills needed to use cutting-edge technologies effectively.

Ung Wun Lam, an alumna of the bachelor's programme in civil engineering, secured a position at the global engineering firm Arup (Macao branch) shortly after graduation. To advance her career, she returned to UM to pursue a master's degree—a decision she views as essential for her professional development. Ung highlights the rapid development of geotechnical engineering and praises UM's curriculum for staying up to date with new technologies and aligning with industry needs. With some work experience under her belt, Ung now has a deeper appreciation of how to apply theoretical knowledge to real-life situations. She shares an example, 'One morning, my supervisor at work taught me how to derive a soil parameter from soil test results. That same evening, my UM professor explained the exact same concept. This synergy not only enhances my learning but also helps me analyse problems more rigorously in my work.'

Enhancing Learning Effectiveness Through Competitions

Prof Zhou notes that civil engineering is a systems science that requires a broad set of skills, including independent learning, teamwork, innovative thinking and problem-solving. To help students develop these skills, the Department of Civil and Environmental Engineering supports their participation in various civil engineering competitions. Over the past three years, students from the department have achieved outstanding results in high-level competitions for university students such as national bridge design competitions and national structure design contests on information technology. UM students consistently rank among the top performers and, in some cases, are the sole awardees from the Greater Bay Area. These competitions also spark student interest in research. Many participants go on to join their supervisors' research teams, further enhancing their academic and professional growth.

Diverse Career Paths

'Civil engineering forms the foundation of social development. Despite rapid transformations in the industry, our graduates consistently find development opportunities worldwide that align with their strength,' Prof Zhou emphasises. Indeed, UM graduates are highly regarded in Macao's civil engineering sector. Nearly half of bachelor's graduates secure positions at engineering firms and contribute to infrastructure development, architectural design, and structural analysis. Over the past three years, one hundred per cent of master's graduates have secured employment, with many pursuing careers in Hong Kong and abroad. Additionally, about half of the bachelor's graduates choose to pursue further studies after leaving UM. Many of them gain admission to world-class institutions, including the National University of Singapore, the University of Hong Kong, the Hong Kong University of Science and Technology, the University of Sydney, and the KTH Royal Institute of Technology in Sweden.

'While the industry experiences cyclical changes, civil engineering is here to stay. It continues to evolve, and our responsibility is to keep pace with these changes and equip students with stronger competitiveness,' Prof Zhou adds. UM's civil engineering education is steadfast in its commitment to serving the community and advancing the industry. The university strives to cultivate professional civil engineers who can seize opportunities amid industry transformations.

學生參觀建築工地，聽業界實地分享。
Students visit a construction site and gain insights from industry professionals

跨學科驅動的電機及電腦工程教育

Advancing Electrical and Computer Engineering Education Through Interdisciplinary Collaboration

文：關家熹｜圖：何杰平、部分由受訪者提供｜英文翻譯：郭麗雅、謝菀菁
Text: Stella Kuan｜Photo: Jack Ho, with some provided by the interviewees｜English Translation: Gloria Kuok, Bess Che

電機及電腦工程教育，旨在培養電氣、電子和電腦領域的專業人士。澳大近年以跨學科融合為利刃，跨越知識邊界，開設前沿課程，充分結合人工智能技術，全力拓展學生的專業視野。畢業生在粵港澳大灣區的就業和創業賽道均成績斐然。

跨學科推動前沿創新

當今，科技迅猛發展的時代，人工智能、物聯網、智能電網等技術正重塑全球產業格局。澳大電機及電腦工程以及物聯網相關課程，均將跨學科知識作為教學重點，將生物醫學工程、電力工程與自動化、微電子、無線通信、物聯網工程及智能系統等領域有效融合。

電機及電腦工程系主任Carlos Silvestre教授表示，澳大電機及電腦工程課程不僅涵蓋傳統工程學科，更積極引入人工智能等新興技術，開設人工智能原理、物聯網數據分析、雲計算等課程，與智慧城市物聯網國家重點實驗室、模擬與混合信號超大規模集成電路國家重點實驗室及產業界合作，確保學生掌握紮實且前沿知識和技能，培養他們具備前瞻性的行業視野。他指出：「時代發展日新月異，課程必須追上步伐，學生方能學以致用。」

理論與實踐雙軌培養

為了提升學生的實際應用能力，澳大電機及電腦工程領域設有嵌入式系統實驗室、控制系統實驗室、無線技術實驗室等，配備行業標準工具Python、TensorFlow和MATLAB，支持學生在開發智能系統、控制系統、微電子、智能電網、生物醫學工程等領域開展實際應用，實現理論知識與實踐操作有機結合。

學士學位課程三年級學生李浩博指出：「相較內地高校，澳大更強調培養應用能力。即使是本科生，教授們也很歡迎我們進入實驗室參與研究項目，鍛鍊動手能力、解決問題的能力，以及研究報告的撰寫能力。」在教授的指導下，他於2023世界機器人大賽–BCI腦控機器人大賽青年組情緒腦機賽項，榮獲預賽第一及決賽三等獎。明年即將畢業，李浩博打算繼續在澳大升讀研究生，持續提升自我。

據了解，在澳大就讀電機及電腦工程相關領域的學生中，每年約有10%學生通過參加本地、周邊地區及國際賽事，提升自身的學術水平和實戰能力。Silvestre教授補充道，和本科生相比，碩士生的實習機會和研究項目的參與度更大，博士生與教授進一步合作發表研究成果。此外，課程更提供大量本地及大灣區企業的實習機會。

緊貼大灣區發展

由於學生所具備的知識，可運用於電氣建築服務、鐵路電氣化系統、電力系統、微電子集成電路設計、無線通訊以及智能系統運算等領域，因此畢業生廣泛任職於包括澳門輕軌、澳門電力公司、澳門廣播電視等企業，擔任電力工程師、系統經理等職位。以2023/2024學年為例，電機及電腦工程系共有32名本科生、32名碩士生和17名博士生，其中70%於畢業後二至三個月內已經成功入職，月薪起薪點由15,000澳門元起，前景可觀。部分畢業生在復旦大學、中山大學、電子科技大學、加拿大西安大略大學等高校執教鞭或任職科研人員。

2021年在澳大取得博士學位後，謝威入選中國科學技術協會青年人才托舉計劃，其後獲上海交通大學聘任，現任長聘教軌副教授，主要研究海洋與港口無人系統自主控制和設計製造。謝威教授表示：「澳大教學及科研設備先進，為我的學術發展奠定堅實基礎。更重要的是，澳大師資優良，來自世界各地的教授不但學術水平高，而且富有教學熱情和耐心。如今我也成為了學生導師，常以澳大的老師們作為榜樣。」

此外，亦有畢業生選擇創業，成立不同類型的科技公司。例如先皓科技，在澳門成立後於珠海進一步建設軟件質量控制中心，業務範圍包括集成大數據、空間地理資訊、呼叫中心等；在橫琴·澳門青年創業谷起家的立芯科技，集中物聯網行業應用服務，包括NFC和RFID硬體、電子標籤和解決方案，應用在服裝、航空、零售、物流、供應鏈、圖書館等行業，服務對象覆蓋世界50多個國家及地區。

隨著粵港澳大灣區建設加速，Silvestre教授認為，必須把握機遇，積極對接區域發展需求，在這一點上，他認為，「澳大資源充足，這是我們的一大優勢。」除了現有的課程改革，澳大未來還計劃開設全新的微電子學學士學位課程和智能電網碩士學位課程，投放更多資源專注培養人工智能技術、智慧能源系統、微電子和機器人方面的人才，助力大灣區城市數位化轉型與可持續發展。

Electrical and Computer Engineering (ECE) education aims to nurture professionals in electrical, electronic, and computer engineering. In recent years, the University of Macau (UM) has introduced cutting-edge programmes that integrate interdisciplinary approaches to push beyond traditional knowledge boundaries. By incorporating advanced technologies such as artificial intelligence (AI) into courses, the university strives to broaden students' professional horizons. These initiatives equip UM graduates to succeed as practitioners and entrepreneurs in the Greater Bay Area.

Fostering Innovation Through Interdisciplinary Collaboration

In an era of rapid technological advancements, transformative technologies such as AI, the Internet

Carlos Silvestre教授
Prof Carlos Silvestre

李浩博
Li Haobo

of Things (IoT), microelectronics, and smart grids are reshaping industries across the globe. In response, UM places strong emphasis on interdisciplinary education. The university's ECE programmes integrate knowledge from diverse fields, including biomedical engineering, electric power engineering and automation, microelectronics, wireless communications, IoT, and intelligent control systems.

According to Prof Carlos Silvestre, head of the Department of Electrical and Computer Engineering, UM's ECE programmes go beyond traditional engineering education by incorporating emerging technologies. For example, the department has introduced courses on AI principles, data analysis for IoT, and cloud computing. It also maintains close collaboration with the State Key Laboratory of Internet of Things for Smart City and State Key Laboratory of Analog and Mixed-Signal VLSI, and industry partners to ensure that students acquire both foundational and cutting-edge knowledge while developing a forward-looking understanding of industry trends. Prof Silvestre explains, 'In this era marked by rapid technological advancements, our programmes must stay aligned with these developments to ensure that students can effectively apply their knowledge in real-world contexts.'

Focusing on Both Theoretical Learning and Practical Skills

To enhance students' practical skills, the Department of Electrical and Computer Engineering has established state-of-the-art facilities, including laboratories for embedded systems, control, and wireless communication. These labs are equipped with industry-standard tools such as Python, TensorFlow, and MATLAB, allowing students to gain hands-on experience in areas such as smart system development, control, microelectronics, smart grids, and biomedical engineering. This setup ensures a seamless integration of theoretical knowledge with practical application.

Li Haobo, a third-year student, shares his experience at UM: 'Compared to universities in mainland China, UM places more emphasis on developing students' practical skills. Even undergraduates are encouraged to join professors' research teams and conduct experiments in the laboratory. This approach significantly enhances our hands-on abilities, problem-solving skills, and academic writing proficiency.' Under the guidance of his professor, Li won first place in the preliminary round and third prize in the finals of the Youth Group Emotional BCI Competition at the 2023 World Robot Contest (WRC)—Brain-Computer Interface (BCI)—Controlled Robot Contest. As he reaches his final year of undergraduate studies, Li plans to continue his academic journey at UM by pursuing a master's degree.

Each year, approximately 10 per cent of UM ECE students participate in local, regional, and international competitions, further enhancing their academic abilities and practical skills. Prof Silvestre adds that master's students enjoy more opportunities to take part in internships and research projects, while doctoral students work closely with professors to conduct research and publish their findings. Additionally, the department offers extensive internship opportunities in enterprises in Macao and the Greater Bay Area.

謝威教授
Prof Xie Wei

Supporting the Development of the Greater Bay Area

UM's ECE programmes equip students with expertise applicable to a wide range of engineering fields, including electrical building services, railway electrification systems, power systems, microelectronic integrated circuit design, wireless communication, and intelligent control. Graduates have secured roles in organisations such as Macao Light Rapid Transit Corporation, Companhia de Electricidade de Macau, and Teledifusão de Macau, working as electrical engineers, systems managers, and more. In the 2023/2024 academic year, the Department of Electrical and Computer Engineering graduated 32 bachelor's students, 32 master's students, and 17 PhD students. 70 per cent of graduates secured employment within two to three months following graduation, and earn an average monthly starting salary of MOP 15,000, underscoring their strong prospects in the job market. On the other hand, some graduates have pursued academic careers as faculty or researchers at prestigious institutions including Fudan University, Sun Yat-sen University, the University of Electronic Science and Technology of China, and Western University in Canada.

Xie Wei, who completed his PhD studies at UM in 2021, exemplifies the success of UM graduates. After graduation, he was selected for the China Association for Science and Technology's Talented Young Scientist Program. Currently, he is a tenured associate professor at Shanghai Jiao Tong University, where he focuses on research on autonomous control and the design of marine and unmanned port systems. Reflecting on his time at UM, Prof Xie says, 'UM provides state-of-the-art teaching and research facilities, which helped build a solid foundation for my academic development. More importantly, UM has exceptional faculty from around the world. They are not only academically accomplished, but also passionate and patient mentors. Now, as a mentor myself, I always look to them as role models.'

學生在基於傳感器的協作機器人實驗室進行研究
Students conduct experiments at the sensor-based cooperative robotics laboratory

Some UM graduates have ventured into entrepreneurship and founded tech companies. One notable example is SinoKru Technology, established in Macao and later expanded to Zhuhai. The company operates a software quality control centre in Zhuhai, offering big data, geospatial information, and call centre services. Another standout example is Laxcen Technology, which was incubated at the Hengqin-Macao Youth Entrepreneurship Valley. The company specialises in IoT applications, including NFC/RFID hardware, electronic tags, and solutions for sectors like apparel, aviation, retail, logistics, supply chains, and libraries, serving clients in over 50 countries and regions.

As the Greater Bay Area continues to develop, Prof Silvestre emphasises the importance of aligning with regional needs and seizing emerging opportunities. He explains, 'UM is well-resourced, which is one of its greatest strengths.' In addition to curriculum reforms, the university plans to launch a new bachelor's programme in microelectronics and a new master's programme in smart grids. It will also dedicate more resources to cultivating talent in AI technologies, smart energy systems, microelectronics, and robotics, with the goal of supporting the Greater Bay Area's digital transformation and sustainable development.

以實用為核心的機電工程教育

Practice-Oriented Electromechanical Engineering Education

文：關家熹｜圖：何杰平、部分由受訪者提供｜英文翻譯：郭麗雅、謝菀菁
Text: Stella Kuan｜Photo: Jack Ho, with some provided by the interviewees｜English Translation: Gloria Kuok, Bess Che

在科技蓬勃發展、各行業加速變革的當下，應用型專業人才成為推動社會進步和產業革新的核心力量。澳大憑藉其紮實的教學體系和前瞻性的教學理念，培育學子深入參與到機電工程的關鍵領域，為行業發展注入源源不斷的動力。

本碩博育才環環相扣

澳大的機電工程本科課程沿用以多元化與實用性為核心的課程體系。機電工程以機械設計為主，需要力學與熱流體、材料、製造等相關知識，再加入機電一體化的應用與控制，屬於跨領域的學科。由於範圍廣泛，澳大的機電工程教育可分為機器人及智能系統、先進材料與製造、流體和熱傳導、屋宇裝備工程四個板塊。機電工程系主任郭志達教授概括道：「與建築物的『風火水電』相關，即冷氣、消防系統、供排水以及電力系統等，均屬於機電工程。」本科學生應多嘗試跨領域學習，裝備多元技能。

碩士課程側重機器人及控制、先進材料與製造、高等熱流體力學、能源、汽車工程等等，並融入嵌入式系統、物聯網等現代技術，強化與產業的銜接能力，學生可選擇專題研究或工程實習，實現理論與實務的緊密結合。博士課程專注於機電工程領域的創新研究，並通過產學研融合，提升學術和科研項目的實用價值。郭教授表示：「本碩博課程的教學內容，從基礎到進階緊密銜接，按階段培養專業技能的應用能力。」

為順應科技發展趨勢，澳大自2023/2024學年起開辦機器人與自主系統碩士學位課程，覆蓋移動機器人、傳感器技術與人工智能等知識領域。相關學士學位課程亦在籌劃中，以更有系統地培育機電工程相關專業人才。

全方位構建實踐平台

現時，澳大設有17間機電工程範疇的實驗室，包括智能無人系統實驗室、汽車工程實驗室、機器人實驗室、太陽能實驗室等。郭教授指出：「實驗室一方面是學術研究的主要設備支撐，另一方面為學生提供多元化實踐平台。」

校友黃寶琪自入讀澳大以來，從機電工程學士、碩士深造到博士，現於母校擔任實驗室行政主任，協助管理多個實驗室。談起在澳大的求學經歷，她表示，學院為學生提供了豐富的學習體驗，通過小組報告、實驗及參觀等形式，強化了學術交流、團隊協作和溝通能力，這些能力在實驗室工作中必不可少。此外，她亦先後在馬爾他和澳門實習。這些實習機會涵蓋了系統設計、生產流程、設施維護、設備管理及倉務管理等多個領域。她指出，「在澳大機電工程系的學習過程中，每個專業範疇都能通過實習來鞏固所學知識，這不但有助於培養創新思維與解決問題的能力，更能讓研究成果直接應用，顯著提升了研究的實用性和針對性，充分體現了理論與實踐結合的重要性，以及澳大在培育學生專業能力方面的卓越成就。」

郭教授鼓勵學生時刻裝備自我，自2022年起，組織機電工程系學生參與全國建築信息模型（BIM）技能等級考試，強化學生的職業技能水平。值得一提的是，該系任教此專業技能的老師已成功考取高級資格，能夠針對性為學生提供培訓。教授們更積極指導學生參加海內外賽事，或於國際研討會發表研究成果，成績斐然。

高需求多元化就業前景

「讀工程，自然期望成為工程師，但考取專業資格需要受認可的工作經驗。我們積極與產業界合作，助力打造快速考取通道。」郭教授說。目前已有九名畢業生在澳門銀河擔任工程師，並加入與香港工程師學會合作開展的工程畢業生培訓計劃，經過為期兩年的職務輪換後，成功獲得受國際認可註冊工程師的報考資格。

除工程師崗位外，機電工程領域的畢業生的就業前景多元。根據近三年的追蹤數據，約61%畢業生在畢業首三個月投身全職工作、31%升學深造、1%創業，其餘7%畢業生六個月內亦已就業。就業領域以工程承包（42%）、設施管理（13%）與工程顧問（15%）為主，除了在本地政府部門、公共事業、綜合度假休閒企業工程部和私人工程公司工作外，亦有畢業生入職三菱重工、奧雅納（ARUP）等大型跨國企業。

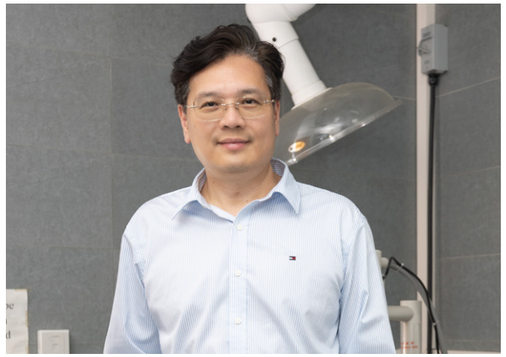
現正就讀博士二年級的林慧怡認為，畢業後可從事專業設備和系統的設計、設備管理維護和檢測、技術支援、建造、設計及管理大型機電工程項目、繪製施工圖和現場協調等工作。她曾在永利皇宮可持續發展部門實習，現時在實驗室開展增材製造、材料表徵和應用方面的研究，積累實際工程經驗。她表示：「澳大經常組織機電工程日、校友分享會、職業講座、企業參訪等活動，增廣見聞之餘，有助建立業界關係網，對學生就業和創業都有莫大裨益。」

從專業技能到產學研應用，澳大時刻關注業界所需，充分結合前沿研究及新興技術，為工程領域積極培養高質素的應用型人才。

As technology advances, industries around the world are undergoing significant transformation. Skilled professionals have become the driving force behind social progress and industrial innovation. With a well-developed education system and forward-looking educational philosophy, the University of Macau (UM) nurtures professionals in the vital field of electromechanical engineering, contributing to the development of related industries.

Progressive Learning Across Bachelor's, Master's, and PhD Programmes

The bachelor's programme in electromechanical engineering at UM features a curriculum that emphasises both diversity and practicality. As an interdisciplinary field, electromechanical engineering



郭志達教授
Prof Kwok Chi Tat

學生於機器人實驗室鍛鍊動手能力
Students practice hands-on skills in the robotics laboratory

focuses on mechanical design, combining knowledge of mechanics, thermo-fluid engineering, materials, and manufacturing with mechatronics and control. Given the wide scope of the field, UM's electromechanical engineering education is divided into four core areas: robotics and intelligent systems, advanced materials and manufacturing, thermo-fluid engineering, and building services. 'Electromechanical engineering encompasses the essential systems of buildings which include HAVC (heating, ventilation, and air conditioning), fire protection, water supply and drainage, and electrical systems,' explains Prof Kwok Chi Tat, head of the Department of Electromechanical Engineering. Undergraduate students are encouraged to explore all four areas to develop a broad skill set.

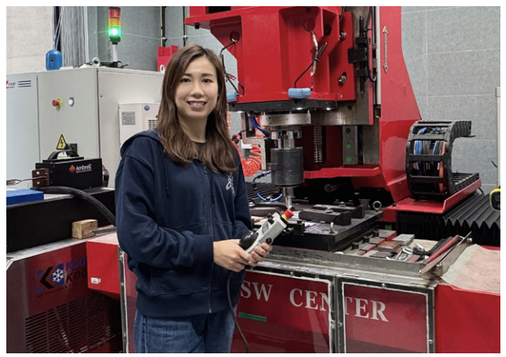
The master's programme in electromechanical engineering focuses on specialised topics such as robotics and control, advanced materials and manufacturing, advanced thermo-fluid engineering, energy, and automotive engineering. Students can choose between a project report or an internship to fulfil their graduation requirement, reflecting the programme's commitment to connecting theoretical knowledge with practical experience. At the PhD level, the emphasis shifts to research innovation in electromechanical engineering. Students have opportunities to collaborate with industry partners to enhance the practical value of their research. 'The bachelor's, master's, and PhD programmes are closely connected, allowing students to progressively develop their applied professional skills at each stage,' says Prof Kwok.

To keep pace with technological advancements, UM launched a master's degree programme in robotics and autonomous systems in the 2023/2024 academic year. The programme covers cutting-edge fields such as mobile robotics, sensor technology, and artificial intelligence. A related bachelor's degree programme is also under development, aiming to systematically cultivate related professionals for the electromechanical engineering field.

Building Diverse Practice Platforms

UM currently has 17 electromechanical engineering laboratories, including an intelligent unmanned systems laboratory, an automotive engineering laboratory, a robotics laboratory, and a solar energy laboratory. Prof Kwok explains, 'The laboratories are essential facilities that support academic research. They also serve as platforms for students to practice and develop diverse skills.'

UM alumna Wong Po Kee began her academic journey at UM as an undergraduate and went on to earn a master's degree and a PhD in electromechanical engineering. She is now working as an officer for laboratory and administrative affairs at UM, where she is responsible for laboratory management. Reflecting on her studies at the university, Wong credits group projects, presentations, experiments and visits with significantly improving her academic communication, teamwork, and problem-solving skills, all of which are essential skills for her current role. She also gained valuable hands-on experience through internships in Malta and Macao, where she worked on system design, production processes, facility maintenance,



黃寶琪
Wong Po Kee

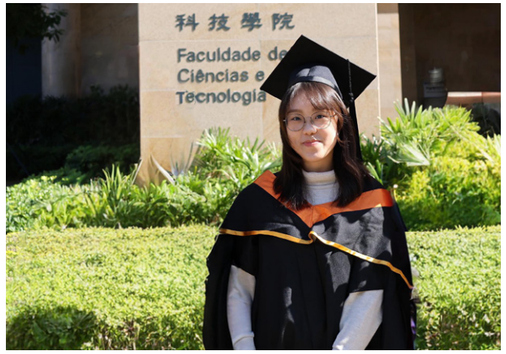
equipment management, and warehouse operations. 'The Department of Electromechanical Engineering ensures that every theoretical concept is reinforced through practical application, which not only fosters innovative thinking and problem-solving skills, but also enables research outcomes to be applied in real-world contexts, making research more practical and relevant. This approach highlights the importance of combining theory with practice, and showcases UM's outstanding achievements in developing students' professional skills,' Wong shares.

As head of the department, Prof Kwok encourages students to improve their professional skills. Since 2022, the department has organised students to take the National Building Information Modeling (BIM) Skill Level Exam to enhance their professional competence. Notably, faculty members who teach this area hold advanced BIM qualifications, allowing them to provide targeted student training. Professors also support students in national and international competitions as well as international conferences, where students consistently achieve outstanding results.

Diverse and High-Demand Career Opportunities

'It is natural for engineering students to aspire to become engineers. However, obtaining professional certification requires recognised work experience. To address this, we work closely with industry partners to make it easier for students to achieve certification,' says Prof Kwok. A good example of this collaboration is the success of nine UM graduates currently employed as engineers at Galaxy Macau. These graduates completed the two-year Scheme 'A' Training Programme developed by the Hong Kong Institution of Engineers, where they gained practical experience through job rotations. The working hours they accumulated in the programme allowed them to fast-track their path to obtaining the internationally recognised qualification of registered engineer.

In addition to traditional engineering roles, graduates of UM's electromechanical engineering programmes enjoy diverse career opportunities. According to tracking data from the past three years, 61% of graduates secured full-time employment within three months of graduation, 31% pursued further studies, and 1% started their own businesses. The remaining 7% were employed within six months of graduation. Key employment sectors included engineering



林慧怡
Lam Wai I

contracting (42%), facility management (13%), and engineering consultancy (15%). Many graduates work in Macao government departments, public utilities, integrated resort engineering departments, and private engineering firms. Others have joined multinational corporations such as Mitsubishi Heavy Industries and Arup.

Lam Wai I, a second-year doctoral student at UM, sees her studies as a gateway to diverse career opportunities in professional equipment and system design, facilities management and maintenance, technical support, construction, large-scale electromechanical project design and management, construction drawing design, and on-site coordination. Previously, she interned in the sustainability department at Wynn Palace, where she gained valuable practical experience in the field. Now, as a doctoral student, she focuses on research on additive manufacturing, materials characterisation and their applications to prepare herself for real-world projects. 'UM frequently organises events like Electromechanical Engineering Day, alumni sharing sessions, career talks, and industry visits. These activities not only broaden our perspectives but also help us build industry networks, which are valuable for students, whether they plan to enter the job market or start their own business,' she shares.

Through specialised training and strong industry-academia collaboration, UM is dedicated to meeting industry needs. By integrating cutting-edge research and advanced technologies, the university strives to cultivate high-quality, practical talent for the engineering sector.

澳大與葡萄牙高校的結緣

UM's Academic Cooperation with Higher Education Institutions in Portugal

文：梁曉珊、葉浩男、資深校園記者王楚月、校園記者李穎曦｜圖：何杰平、部分由受訪者提供｜英文翻譯：關詠琪

Text: Bell Leong, Davis Ip, Senior UM Reporter Wang Chuyue, UM Reporter Tracy Li｜Photo: Jack Ho, with some provided by the interviewees｜English Translation: Winky Kuan

澳門，憑藉其獨特的歷史文化底蘊，在中國與葡萄牙的交流合作中發揮重要的平台作用。澳門大學以鮮明的國際化特色，積極搭建起連接中國與葡語國家的學術橋樑。近年，澳大與里斯本大學、科英布拉大學、波爾圖大學等葡萄牙知名學府進一步攜手合作，在學術交流、科研合作、學生交換、聯合實驗室建設、雙博士學位人才聯合培養等方面取得堅實的成果。

合作源遠流長

1992年，懷著學術夢想和使命的澳大副校長馬許願教授，獲里斯本大學特別外訪許可，從葡萄牙不遠萬里來到澳門，自此成為推動澳大與葡語高校交流合作的核心人物之一。他對中葡文化及學術合作有著豐富經驗和卓越見解，「澳大一直肩負聯繫中國內地、澳門與葡萄牙的非凡使命。」

追溯往昔，澳大自前身東亞大學創校起，便與葡萄牙高等學府緊密聯繫。早於1980年代，澳大與里斯本大學締結姊妹大學關係，開啟長期合作。澳大與波爾圖大學、科英布拉大學的合作同樣源遠流長。馬許願教授介紹，澳大與波爾圖大學的合作可追溯到1993年，雙方簽署協議，開展聯合研究、教師交流等合作。1995年，澳大與科英布拉大學、北京外國語大學透過合作協議，促進在研究、教育等領域的交流。如今，合作關係更滲透到前沿科學研究、聯合人才培育等更多領域。

建設聯合實驗室

澳大與科英布拉大學的最新一份合作協議於2023年10月簽署，成立「認知老化聯合實驗室」。澳大認知與腦科學研究中心主任袁振表示，「該聯合實驗室就像是匯聚了兩校認知神經科學領域專家的學術殿堂，我們經常朝著認知老化的神經機制、病理性衰老的早期檢測、生命周期中大腦與認知的關係等關鍵問題發起衝擊，在一場場聯合研究、師生交流、學術活動中頭腦激盪。我們亦有計劃共同培養博士人才，促進學術創新。」

2024年9月，又一個令人振奮的消息傳來，澳大和葡萄牙健康研究與創新研究所（i3S）合作成立「精準納米醫學聯合實驗室」。負責該聯合實驗室的澳大中華醫藥研究院教授王瑞兵指出：「精準納米醫學是具革命性的前沿研究領域，有廣闊的應用前景。聯合實驗室著力開發先進藥物的遞送系統，涵蓋刺激響應型納米載體、微納米機器人靶向藥物遞送、癌症免疫治療等，期望為患者提供個性化的創新精準療法。」

合辦雙博士學位課程

在人才聯合培育的道路上，澳大延續25年前與里斯本大學高等技術學院共同培養雙博士的傳統，與葡萄牙高校的合作再次邁出重要步伐。澳大與波爾圖大學以精準納米醫學聯合實驗室的共享專業知識和先進設備為基礎，合辦全新雙博士學位課程。來自波爾圖大學的Sofia　Costa，是該雙博士學位課程的首批學生，導師正是精準納米醫學聯合實驗室的王瑞兵教授。

2024年，Sofia帶著對學術的渴望來澳，她的研究興趣聚焦於微納米馬達的合成、腫瘤晶片藥物篩選平台的開發，尤其致力探索納米藥物作為治療罕見的兒童骨癌——骨肉瘤的新替代方案。她認為，雙博士學位課程結合了兩所知名高校的優勢，助其實現科研目標。她形容來到澳門不僅是一個提高學術造詣的機會，更是一趟跨文化旅程。「對於一些複雜的科研問題，不同文化背景的研究人員能各自提供獨特的視角，帶來創新性的解決方案，我亦在這個包容協作的環境中逐漸建立起科研網絡。」

此外，2023年12月，澳大亦與里斯本大學簽署雙博士學位項目合作協議，開展高層次人才聯合培養合作，聚焦微電子、機器人技術、海洋科學等前沿領域，為博士生打開了跨越思維與地域界限的學術大門。與里斯本大學淵源深厚的澳大副校長馬許願教授說：「兩校就像並肩作戰的朋友，相互推薦優秀博士生參與雙博士學位課程，共同培育高質素人才，獻力於學術研究，拓展學術合作的深度與廣度。」

學生赴葡學習

澳大與葡萄牙高校在學生交流層面的合作持續進行，為不同專業的學生創造多元學習體驗。科英布拉大學、波爾圖大學等13所葡萄牙高等學府為澳大學生提供沉浸式的學習平台，澳大每年均透過不同項目輸送學生赴葡學習。目前，共有12位澳大交換生在葡萄牙學習，另外還有24位學生透過法學士學位課程（中葡雙語授課）、32位學生透過葡文系「海外留學計劃」赴葡。

語言學習中，語言及文化環境的作用舉足輕重。澳大葡文系作為亞洲最大的葡語教學單位，每年輸送學生赴葡學習語言及文化。葡文系四年級學生繆詠琪曾在科英布拉大學交流學習一年，這段經歷讓她體會至深：「課堂上，我有機會挑戰即興閱讀材料、進行課堂報告，在全葡語環境中提升語言應用能力；課堂外，我盡情探索葡萄牙風土人情，結識了來自世界各地的朋友，在多元文化的碰撞中開拓了視野，從而也讓自己對未來有了更多探索人生不同可能的勇氣。」

馬許願教授
Prof Rui Martins

葡萄牙法律在澳門的法律體系中佔據重要定位，為讓學生深入了解法律根源與發展，澳大法學院為五年制法學士學位課程（中葡雙語授課）學生提供赴葡機會。法學系四年級學生林詠琳在波爾圖大學獲益良多，她說：「在波爾圖大學，互動討論是課堂的重要一環，教授經常鼓勵我們勇於提出觀點，在每一次思想的碰撞中加深對知識的理解。教學也不局限於課堂，學生可以透過每周的課外活動，深入了解葡萄牙的歷史文化，透過撰寫報告將理論與實踐相結合。」

深化合作聯盟

澳大不但是葡萄牙大學校長委員會（CRUP）特邀會員，更歷任葡萄牙語大學聯會（AULP）主席（2014至2017年）及多任副主席（2005至2014年，2021至2027年）。另外，澳大還於2021及2022年分別倡議成立中國澳門特別行政區與葡語國家學術圖書館聯盟、澳門特別行政區與內地學術圖書館葡語資源聯盟及中國與葡語國家海洋研究聯盟，充分發揮澳大自身優勢，積極參與各類學術活動，致力促進葡語高校間的合作與交流，以及全球的葡語教育發展。

2026年6月，澳大將承辦第35屆AULP年會，進一步鞏固澳大在葡語高校學術合作中的角色。馬許願教授表示：「澳大獲選再次承辦年會，是澳門進一步成為葡語世界學術交流樞紐的契機。我們期待邀請來自葡語系國家及地區的高等教育專家，探討如何加強建設中國與葡語系國家的國際合作平台，推動教育與科研合作。澳大將持續拓展全球高校合作網絡，為國際教育與科研發展貢獻力量。」

Macao, with its unique history and cultural heritage, plays a pivotal role as a platform for exchange and cooperation between China and Portugal. Therefore, the University of Macau (UM), distinguished by its strong international character, has actively built bridges connecting academic institutions in China and Portuguese-speaking countries. In recent years, UM has forged deep partnerships with leading Portuguese institutions such as the University of Lisbon, the University of Coimbra, and the University of Porto, and has made significant progress in academic exchange, research collaboration, student exchange, the establishment of joint laboratories, and the launch of dual PhD programmes.

袁振教授
Prof Yuan Zhen

Establishing Long-Standing Partnerships

Prof Rui Martins, vice rector of UM, travelled from Portugal to Macao in 1992 with special permission from the University of Lisbon to pursue his academic aspirations overseas. Since that time, he has become a key figure in fostering exchange and cooperation between UM and Portuguese-speaking institutions. ‘UM shoulders the mission of linking mainland China, Macao, and Portugal,’ says Prof Martins, who has extensive experience and insight into Chinese and Portuguese cultures and academic collaboration.

UM’s ties with Portuguese institutions date back to the early days of its predecessor, the University of East Asia. As early as the 1980s, UM established a sister-university relationship with the University of Lisbon, marking the beginning of a long-term partnership. UM’s connections with the University of Porto and the University of Coimbra also have deep roots. According to Prof Martins, UM signed an agreement with the University of Porto in 1993 to conduct joint research and faculty exchanges. In 1995, UM, the University of Coimbra, and Beijing Foreign Studies University entered into a partnership to promote exchanges in research and education. Today, these partnerships have grown to include cutting-edge scientific research and joint talent development, among other areas.

Establishing Joint Laboratories

The latest cooperation agreement between UM and the University of Coimbra was signed in October 2023, leading to the establishment of the Joint Laboratory of Cognitive Aging. Prof Yuan Zhen, head of UM’s Centre for Cognitive and Brain Sciences, says, ‘This joint laboratory serves as an academic hub that brings together experts in cognitive neuroscience from both universities. We tackle critical questions such as the neural mechanisms of cognitive aging, early detection of pathological aging, and the relationships between the brain and cognition across the lifespan. We also engage in dynamic intellectual discourse through various joint research projects, student and faculty exchanges, and academic events. In addition, we plan to train doctoral students through joint programmes to foster academic innovation.’

In September 2024, another exciting partnership emerged as UM and Portugal’s Institute for Research and Innovation in Health (i3S) established the Joint Laboratory of Precision Nanomedicine. Prof Wang Ruibing, professor in UM’s Institute of Chinese Medical Sciences, who also leads the joint laboratory, says, ‘Precision nanomedicine is a revolutionary and cutting-edge research field with broad application prospects. The joint laboratory is dedicated to developing advanced drug delivery systems, including stimuli-responsive nanocarriers, micro/nanorobots for targeted drug delivery, and cancer immunotherapy. Our ultimate goal is to provide patients with personalised, innovative precision therapies.’

Sofia Costa

王瑞兵教授
Prof Wang Ruibing

Offering Dual PhD Programmes

Continuing the tradition established 25 years ago of awarding dual PhD degrees with the Instituto Superior Técnico of the University of Lisbon, UM and higher education institutions in Portugal have taken further steps to promote joint talent development. UM and the University of Porto have launched a dual PhD programme that capitalises on the shared expertise and advanced facilities of the Joint Laboratory of Precision Nanomedicine. The first cohort includes Sofia Costa, a University of Porto student, whose supervisor is Prof Wang Ruibing of the joint laboratory.

In 2024, Sofia arrived in Macao with a thirst for academic excellence. Her research focuses on micro/nanomotor synthesis and the development of tumour-on-a-chip drug screening platforms, with a particular emphasis on exploring nanomedicine as a novel alternative treatment for osteosarcoma—a rare childhood bone cancer. She believes that the dual PhD programme combines the strengths of both prestigious universities and can help her achieve her research objectives. For Sofia, coming to Macao is more than an opportunity to enhance her academic prowess—it is a cross-cultural journey. ‘When tackling complex research challenges, researchers from different cultural backgrounds can offer unique perspectives that lead to innovative solutions. I’m gradually building my research network in this inclusive, collaborative environment,’ she says.

Additionally, in December 2023, UM signed an agreement with the University of Lisbon for a dual PhD programme, initiating cooperation in the training of high-level talent in cutting-edge fields such as microelectronics, robotics, and ocean science. The programme opens an academic gateway that transcends intellectual and geographical boundaries. Prof Martins, who maintains deep ties with the University of Lisbon, says, 'The two universities are like comrades-in-arms, recommending outstanding doctoral students for the dual PhD programmes. Together, we are nurturing high-calibre talent, contributing to academic research, and enhancing the depth and breadth of academic cooperation.'

Sending Students to Study in Portugal

UM continues to strengthen its student exchange initiatives with higher education institutions in Portugal, offering students diverse learning experiences across various disciplines. Thirteen Portuguese institutions—including the University of Coimbra and the University of Porto—provide immersive learning platforms for UM students. Every year, UM sends students to Portugal through several exchange programmes. Currently, many UM students are studying in Portugal—12 through exchange programmes, 24 in the Bachelor of Law programme (conducted in both Chinese and Portuguese), and 32 via the Department of Portuguese's Study Abroad Programme.

The linguistic and cultural environment plays a crucial role in language learning. As the largest Portuguese teaching body in Asia, UM's Department of Portuguese sends students to Portugal every year for linguistic and cultural immersion. Mio Weng Kei, a fourth-year student of Portuguese studies, spent a year studying at the University of Coimbra—an experience that had a profound impact on her. She recalls, 'In class, I had the opportunity to practice impromptu speaking and give presentations, and my language skills were greatly improved in a Portuguese-speaking environment. Outside the classroom, I immersed myself in Portuguese culture, made friends from all over the world, and broadened my horizons through cultural exchange. This journey gave me the courage to explore different possibilities in life.'

Portuguese law plays an important role in Macao's legal system. To deepen students' understanding of the origins and development of Macao law, UM's Faculty of Law offers students enrolled in the five-year Bachelor of Law programme (conducted in both Chinese and Portuguese) the opportunity to study in Portugal. Lam Weng Lam, a fourth-year law student, shares her enriching experience at the University of Porto: 'Discussion is an important part of the classes at the University of Porto,' she says. 'The professors there encouraged us to express our opinions, and our understanding of knowledge was deepened through intellectual exchange. In addition, learning goes beyond classroom lectures—we explored Portugal's history and culture through weekly extracurricular activities. We also integrated theoretical knowledge with practical experience through written assignments.'

繆詠琪
Mio Weng Kei

林詠琳
Lam Weng Lam

澳大與葡萄牙健康研究與創新研究所建設「精準納米醫學聯合實驗室」
UM and Portugal's i3S launch the Joint Laboratory for Precision Nanomedicine

Deepening Cooperation Among Alliance Members

UM holds a prominent position in the Portuguese-speaking academic community, not only as an invited member of the Council of Rectors of Portuguese Universities (CRUP), but also through its leadership role in the Association of Portuguese Speaking Universities (AULP). The university has served as president of AULP (2014-2017) and has held multiple terms as vice president (2005-2014, 2021-2027). Furthermore, in 2021 and 2022, UM initiated the establishment of several academic alliances: the Academic Library Alliance between Macao Special Administrative Region and Portuguese-speaking Countries, the Academic Library Alliance for Portuguese Language Resources between Macao Special Administrative Region and Mainland China, and the China-Portuguese Speaking Countries Ocean Research Alliance. Through these platforms, the university further leverages its strengths, actively participates in various academic events, fosters cooperation and exchanges among Portuguese-speaking institutions, and promotes Portuguese-language education on a global scale.

In June 2026, UM will host the 35th annual meeting of AULP, further strengthening its role in academic cooperation with Portuguese-speaking institutions. Prof Martins says, 'Being selected to host this meeting again marks a milestone in Macao's emergence as a hub for academic exchange in the Portuguese-speaking world. We look forward to bringing together higher education experts from Portuguese-speaking countries and regions to explore ways to strengthen the international cooperation platform between China and Portuguese-speaking countries, and promote cooperation in education and research. UM will continue to expand its partnership network with higher education institutions around the world, and contribute to international education and research development.'

葡文版
Article in Portuguese
Artigo em português

抗炎研究，精準「滅火」

Anti-Inflammation Research: Precision ‘Firefighting’ to Protect Health

文：余偉業｜圖：由受訪者提供｜英文翻譯：余偉業、謝菀菁
Text: Kelvin U｜Photo: Provided by the interviewees｜English Translation: Kelvin U, Bess Che

我們的身體每天都在上演「消防隊」與「火災」的拉鋸戰——正常的免疫系統猶如訓練有素的「消防隊」，一旦察覺身體異常的「火災隱患」，就會啟動防禦機制。但當免疫系統過度活躍，就有機會令「火災失控」引發慢性發炎，從皮膚紅癢、關節疼痛到癌症復發，猶如不斷蔓延的大火，威脅健康。澳門大學的研究團隊正化身為「免疫消防員」，在「治標不治本、用藥怕副作用」的傳統治療以外尋找「滅火」新利器，致力從根本上解決炎症問題，守護人類健康。

皮膚炎症失控的救星

皮膚發炎已成為都市人無法忽視的健康隱憂。據內地「智研諮詢」統計，近1/10中國人受皮膚炎困擾，其中濕疹患者高達7,000萬。許多患者因痕癢劇烈夜不能寢，甚至抓破皮膚導致感染，產生自卑心理。而傳統的類固醇藥膏副作用大；生物製劑雖有效但價高，患者年均治療費需一萬元，許多家庭難以負擔。

澳大的最新研究或帶來轉機。中華醫藥研究院梁重恒教授團隊發現，皮膚發炎的核心機制在於名為Keap1-Nrf2的「蛋白質開關」。Nrf2蛋白能指揮細胞抗炎，維持皮膚穩定；發炎時，Keap1蛋白「綁架」Nrf2致其失效，導致炎症失控，「火勢」愈演愈烈。

過去科學家嘗試直接激活Nrf2，但這種方法如同「亂打密碼」，可能干擾其他生理功能並引發副作用。梁教授團隊突破性地研發出「蛋白質偵探」技術，利用特殊銥金屬探針標記Keap1蛋白，使其無所遁形；再透過高通量篩選，快速識別能有效分離Keap1與Nrf2的活性成分，讓「滅火隊」重新上工。研究團隊通過系統篩選藥物與中藥成分庫，發現一種中藥材提取物能精準拆解Keap1-Nrf2蛋白複合體。該成分不僅展現出顯著的抗炎活性，且安全性良好，溫和無刺激。基於當前生產成本評估，該產品有望以大眾可負擔的價格上市。

「這不是粗暴壓制症狀，而是為皮膚提供『防護罩』，教會它自我調節。」梁教授生動比喻。該技術已準備申請專利，並獲得化妝品企業青睞，首款抗炎護膚品預計於不久將來推出。

撲救慢性炎症的「溫火」

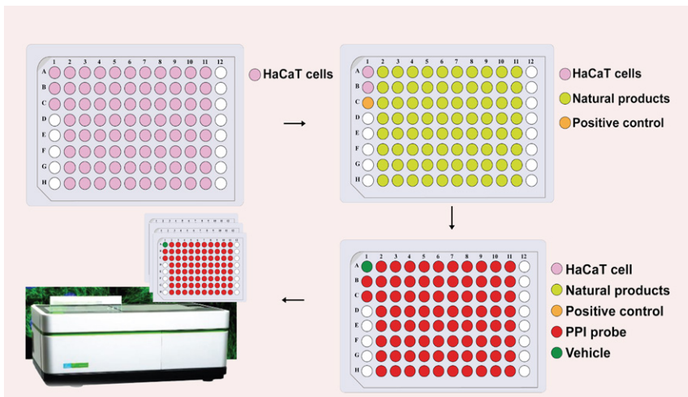
慢性炎症，正如「寂靜的溫火」，以低強度的方式，在不知不覺中入侵人體持續數月甚至數年。如上班族因久坐或坐姿不良導致頸肩肌肉緊繃，引發慢性肌肉勞損；中老年人常見的骨關節退化及關節炎；運動愛好者訓練過度或恢復不足，導致韌帶和肌腱損傷並觸發慢性肌腱炎等。

針對上述情況，中華醫藥研究院副教授何承偉率領團隊，系統篩選了數十種藥用植物，最終發現煙豆（澎湖大豆）具有顯著的抗炎潛力。煙豆主要分佈於福建和台灣地區，在傳統醫學中有祛風濕、益脾腎、壯筋骨等功效，但其抗炎藥效及機制一直未被闡明。通過現代藥理研究，團隊首次證實煙豆中的「香豆雌酚」與「異黃酮類化合物」能同時精準調控SYK、TAK1、PI3K、NF-κB等多條炎症信號通路，如同「精準滅火系統」般抑制慢性炎症，還能促進骨骼修復，改善骨質疏鬆。

基於此發現，團隊融合傳統智慧與現代科技，成功研發「澳門一條筋」外用貼片，用於舒筋活絡、行氣活血，有效緩解慢性炎症疼痛。目前團隊已獲四項發明專利，並與醫療用品公司進行產業化合作。何教授說，「一條筋」命名自明末清初「一條根」的民間典故，傳說金門島民眾以煙豆根煮茶製酒，成為治療將士因不適應海島氣候導致風濕疼痛的良藥。「我們用現代科技驗證民間智慧，『一條筋』既傳承歷史，也象徵澳門科研人員『一條心』的堅持。」

智能消炎的新突破

在醫學領域，巨噬細胞的平衡，猶如健康的精密調節器。M1型巨噬細胞是身體的「防衛軍」，負責攻擊病原體，但過度活化會導致慢性發炎，傷口難癒；M2型巨噬細胞則像「修復工程師」，促進組織再生，但數量過多卻可能促進腫瘤轉移。



基於競爭性發光的抗炎化合物高內涵篩選（HCS）流程
Competitive luminescence-based high-content screening (HCS) process for identifying anti-inflammatory compounds

梁重恒教授
Prof Leung Chung Hang

面對這些難題，澳大應用物理及材料工程研究院教授曲松楠團隊深入分析後發現，現有治療方法存在三個關鍵性局限：M1和M2之間的免疫應答可由包括水凝膠在內的天然生物材料調節，但水凝膠的剛性交聯結構無法適應組織修復中的微環境需求；在腫瘤的免疫治療中，腫瘤相關巨噬細胞（TAMs）形成免疫抑制屏障，令免疫治療效果大打折扣；更重要的是，慢性傷口的治療缺乏精準調控免疫微環境的手段。這些發現令團隊萌生新構想：能否開發一種能主動與免疫系統「對話」的智能材料，從根源上解決這些問題？

研究團隊經過多年探索，終有突破性成果。他們將天然雞蛋清蛋白與納米碳點結合，研發出創新材料「碳點蛋清凝膠」，其帶有獨特的動態交聯結構，可隨組織修復階段自主調整；精密的時序藥物釋放系統，可準確對應各治療窗口期的需求；最關鍵的是，能直接參與免疫微環境重編程，精準調控巨噬細胞的表現型（攻擊或修復模式）。這項技術的誕生，標誌著生物材料從單純的「結構載體」向智能「免疫調控平台」的質的飛躍。

當凝膠注射至癌症腫瘤切除部位時，其納米碳點會像精準的導航系統，定向募集巨噬細胞，將原本促進腫瘤生長的M2型轉化為抗癌活性的M1型；它還能阻斷癌細胞的PD-L1表現，有效激活T細胞的免疫功能。這種創新療法已通過動物實驗，顯示能顯著降低腫瘤復發率，為癌症術後治療開闢新途徑。

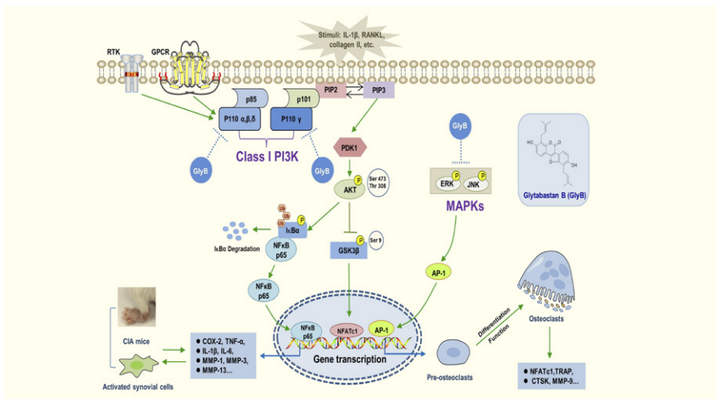
對於慢性傷口，智能凝膠同樣帶來革命性的解決方案。它依據傷口癒合階段持續釋放修復信號分子，將過度活躍的M1型巨噬細胞轉化為修復型的M2型，有望大幅降低糖尿病患者的截肢風險。這項技術在毛囊再生領域也展現出功效，凝膠的降解速率與毛囊生長周期自然同步，通過精準調節免疫微環境，激活休眠的毛囊幹細胞，為病理性脫髮患者帶來曙光。

相關成果已發表於*Advanced Science*和*Advanced Materials*等國際頂尖期刊，並獲內地發明專利授權。該項目已入駐澳大創新創業中心孵化培育，預計兩年內啟動臨床試驗。曲松楠教授指出：「這不僅是一種新型醫療材料，更是一個具有廣闊應用前景的治療平台，有望應用於更多免疫疾病的治療領域。」

澳大「科學滅火隊」的消炎哲學

反覆難癒的皮膚癬疹、糾纏不休的關節疼痛，到癌症術後的復發危機，看似不相關的健康問題，元兇都是免疫系統的失衡。澳大「科學滅火隊」拒絕「強行滅火」的傳統抗炎策略，而是尋找「重啟」免疫系統的新方法，喚醒人體自身平衡。期待這些創新研究從實驗室走向臨床、邁向市場，幫助更多人擺脫發炎威脅，重獲健康平衡。

何承偉教授
Prof He Chengwei



煙豆抗炎活性的分子機制
The molecular mechanisms underlying the anti-inflammatory properties of *Glycine tabacina*

Every day, often hidden from notice, our bodies are locked in a constant tug-of-war between ‘firefighters’ and ‘fires’. The human immune system, acting as a well-trained fire brigade, springs into action the moment it detects abnormal fire hazards in the body. However, when the immune system becomes overactive, it can spark uncontrolled fires, leading to chronic inflammation. From skin redness and itching to joint pain and even cancer recurrence, these inflammation-related problems can spread like wildfire, threatening our health. At the University of Macau (UM), research teams have taken on the role of ‘immune firefighters’, working to find innovative ways to extinguish these fires. Unlike traditional treatments that only manage inflammation symptoms or come with unwanted side effects, the work of these researchers focuses on addressing the root causes of inflammation, providing better protection for human health.

Rescue for Uncontrolled Skin Inflammation

Skin inflammation is an increasingly common health concern in urban areas. According to statistics from Zhiyan Consulting Group in China, nearly one in ten people in the country suffer from dermatitis, with over 70 million affected by eczema. Many patients experience such intense itching that it disrupts their sleep, and some even scratch their skin until it bleeds, leading to infections and a loss of self-esteem. Traditional steroid treatments can come with serious side effects. While biologics are effective, they are expensive, with annual treatment costs reaching RMB 10,000, making them unaffordable for many families.

Thanks to groundbreaking research at UM, a breakthrough may be on the horizon. Prof Leung Chung Hang, professor in the Institute of Chinese Medical Sciences (ICMS), and his research team have discovered a key mechanism behind skin inflammation—a ‘protein switch’ called Keap1-Nrf2. The Nrf2 protein plays a crucial role in directing cells to fight inflammation and maintain skin homeostasis. However, during inflammation, the Keap1 protein ‘kidnaps’ Nrf2, shutting it down and allowing the inflammation to escalate, similar to a fire that grows more intense over time.

Previous attempts to treat inflammation focused on directly activating Nrf2. However, this approach was much like a random guess at a password, risking interference with other physiological functions and causing unwanted side effects. Prof Leung’s team has made a breakthrough with their ‘protein detective’ technology. By using iridium probes, they are able to tag the Keap1 protein, making it impossible for the protein to hide. Then, with high-throughput screening, they can quickly identify active compounds capable of effectively separating Keap1 from Nrf2, allowing the ‘fire brigade’ to get back to work.

Through systematic screening, the team has also discovered that an extract from a Chinese herbal medicine can precisely dismantle the Keap1-Nrf2 protein complex. This extract not only shows impressive anti-inflammatory effects, but is also safe, gentle, and non-irritating. Based on current cost evaluations, products made with this extract could be widely available at an affordable price.

‘Rather than brutally suppressing symptoms, our technology provides a protective shield for the skin and helps it learn to self-regulate,’ Prof Leung explains vividly. The team is preparing to apply for a patent for their technology and has drawn interest from cosmetics companies, with the first anti-inflammatory skincare product expected to launch in the near future.

Putting Out the ‘Slow-Burning Fire’ of Chronic Inflammation

Chronic inflammation, like a slow-burning fire, can quietly harm the body and last for months or even years. For example, office workers often suffer from chronic muscle strain caused by sitting for long periods and poor posture, which leads to stiff necks and shoulders. Middle-aged and elderly people commonly experience osteoarthritis or arthritis, while sports enthusiasts may develop chronic tendinitis from ligament and tendon injuries caused by overtraining or insufficient recovery.

To address these issues, Prof He Chengwei, associate professor in ICMS, working with his team, systematically screened dozens of

medicinal plants. They discovered that *Glycine tabacina* (煙豆), a plant commonly found in Fujian and Taiwan, possesses remarkable anti-inflammatory potential. In traditional Chinese medicine, *Glycine tabacina* is used to relieve dampness, support the spleen and kidneys, and strengthen muscles and bones. However, its anti-inflammatory efficacy and mechanisms have not been fully explored. Through modern pharmacological research, Prof He's team revealed for the first time that coumestrol and isoflavonoids in *Glycine tabacina* can precisely regulate multiple inflammatory signalling pathways, including SYK, TAK1, PI3K, and NF-κB. Functioning like a 'precision firefighting system', these compounds not only reduce chronic inflammation but also promote bone repair and improve osteoporosis.

Building on this discovery, the team combined traditional wisdom with modern technology to develop 'Macao One Root'—a topical adhesive that can relax muscles, improve circulation, and effectively alleviate chronic inflammatory pain. This innovative product has already secured four invention patents, and the team is collaborating with medical product companies to scale up production. Prof He explains that the Chinese nickname for *Glycine tabacina*, 'One Root' (一條根), comes from a folk tale about a legendary herbal remedy in the Ming-Qing Dynasty. According to the tale, residents of the Kinmen Islands brewed tea or wine from *Glycine tabacina* roots to ease the rheumatic pain of soldiers struggling to adapt to the islands' climate. 'With modern technology, we are able to validate this ancestral knowledge. The "Macao One Root" patches honour history while demonstrating the dedication of Macao researchers,' says Prof He.

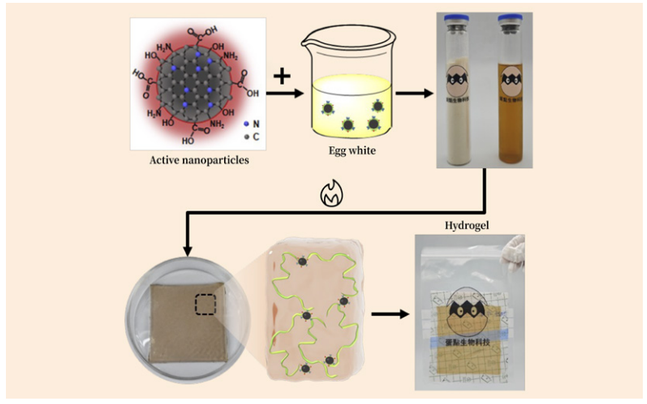
Groundbreaking Smart Anti-Inflammatory Biomaterial

In medicine, the balance of macrophages functions like a precise regulator of health. M1 macrophages act as the body's 'defence forces', responsible for attacking pathogens. However, if overactivated, they can cause chronic inflammation and disrupt the wound-healing process. On the other hand, M2 macrophages function as the body's 'repair engineers', promoting tissue regeneration. Yet, an excessive presence of M2 macrophages may promote tumour recurrence or suppress hair follicle regeneration.

To address these challenges, Prof Qu Songnan, professor in the Institute of Applied Physics and Materials Engineering, and his team conducted in-depth analysis and identified three key limitations in current therapies. First, although natural biomaterials like hydrogels can modulate immune responses between M1 and M2 macrophages, the rigid crosslinked structure of hydrogels cannot adapt to the dynamic microenvironment needed for tissue repair. Second, in tumour immunotherapy, tumour-associated macrophages (TAMs) form an immunosuppressive barrier that significantly reduces the effectiveness of treatments. Finally, and most critically, existing treatments for chronic wounds lack precise methods to regulate the immune microenvironment. These findings prompted the team to raise an ambitious question: Could an intelligent material be developed to actively 'communicate' with the immune system and tackle these challenges at their root?

After years of research, the team achieved a major breakthrough. By combining natural egg white protein with carbon nanodots, they created an innovative biomaterial called the 'carbon-dot-linked egg white hydrogel'. This material features three transformative capabilities. First, it has an adaptive dynamic crosslinking structure that responds to the changing needs of tissue regeneration at different stages. Second, it incorporates a chronologically programmed drug delivery system that aligns precisely with therapeutic windows. Finally, and most critically, it can directly reprogramme the immune microenvironment by precisely modulating macrophage phenotypes (M1/M2 polarisation). This breakthrough marks a paradigm shift in biomaterials, evolving them from passive structural carriers into active systems that can modulate immune responses.

曲松楠教授
Prof Qu Songnan



碳點蛋清凝膠的合成示意圖
Synthesis of the 'carbon-dot linked egg white hydrogel'

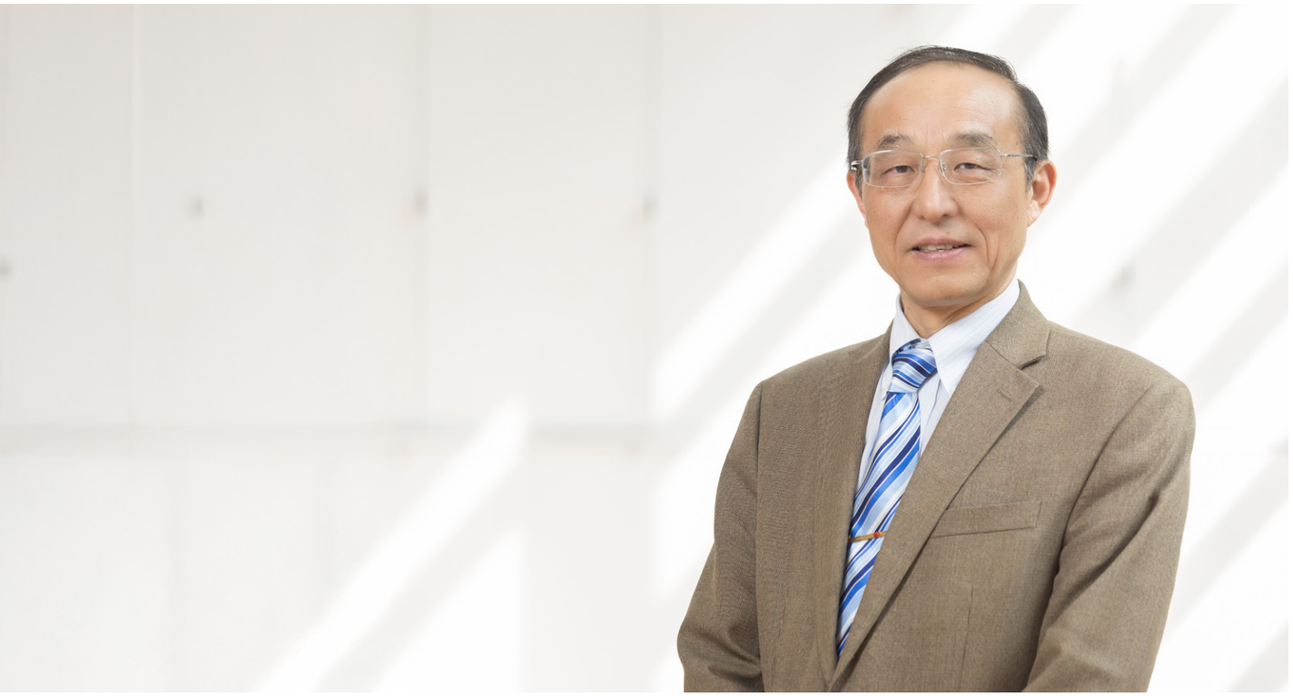
When applied to tumour resection sites, the carbon nanodots within the hydrogel function as a sophisticated precision guidance system. They effectively repolarise tumour-associated macrophages, shifting them from pro-tumour M2 phenotypes to tumour-suppressing M1 phenotypes. At the same time, they activate T cell-mediated immunity by disrupting PD-L1 expression on cancer cells. This innovative therapy has demonstrated remarkable efficacy in animal trials, significantly reducing tumour recurrence rates and presenting a groundbreaking postoperative treatment strategy.

The smart hydrogel also offers a revolutionary solution for chronic wounds. By releasing stage-specific regenerative signalling molecules, it transforms overactive M1 macrophages into pro-healing M2 phenotypes, significantly reducing the risk of amputations in diabetic patients. Equally impressive is its efficacy in hair follicle regeneration. The hydrogel's degradation rate naturally synchronises with the hair growth cycle, while its precise immunomodulation activates dormant follicular stem cells, providing new hope for patients suffering from alopecia.

Prof Qu and his team's groundbreaking research has been published in leading international journals, including *Advanced Science* and *Advanced Materials*, and has been granted invention patents in mainland China. The project is now incubated at the UM Centre for Innovation and Entrepreneurship, with clinical trials expected to begin in two years. Emphasising the broader impact of their work, Prof Qu says, 'This is not just a new material. It also serves as a versatile therapeutic platform with the potential to transform treatments for immune-related diseases.'

UM's Anti-Inflammatory Philosophy

From persistent skin rashes and chronic joint pain to cancer recurrence, many seemingly unrelated health issues stem from a common root cause: immune system dysregulation. Instead of relying on conventional immunosuppressive approaches, UM's 'fire brigade' is pioneering innovative methods to reboot the immune system and restore the body's natural balance. We look forward to seeing these groundbreaking studies move from the laboratory to clinical applications and, ultimately, to the market. This will offer hope to countless individuals in overcoming the challenges of inflammation and reclaiming their health and well-being.



以科學測量優化科學教育——專訪柳秀峰教授

Optimising Science Education Through Scientific Measurement: An Interview With Prof Liu Xiufeng

文：關家熹｜圖：何杰平、部分由受訪者提供｜英文翻譯：謝菀菁
Text: Stella Kuan｜Photo: Jack Ho, with some provided by the interviewee｜English Translation: Bess Che

在全球教育研究的前沿陣列中，有一位領軍人物備受矚目，他便是柳秀峰教授。深耕教育研究逾30載，見證科技進步、世代變遷，他一直堅信，科學教育是人類社會前行必不可少的基石，而終其目標，便是提升人類的科學素養。如今，作為澳門大學教育學院講座教授、教育測驗與評核研究中心主任，柳秀峰教授正以深厚積澱與卓越智慧，為教育事業持續賦能。

從教書到教育研究

柳秀峰教授與教育結緣，當從1978年說起。他是內地恢復全國高考後的首屆大學生，畢業後成為化學老師，邊教書邊鑽研教學方法。為了進修，他考入華東師範大學攻讀碩士，畢業後任職於中國教育科學研究院（時為中央教育科學研究所）。

1989年，在不列顛哥倫比亞大學教育學院數學與科學教育系時任系主任David Robitaille教授的鼓勵下，柳教授遠赴該校讀博深造。畢業後，他於加拿大和美國的高校任職，從助理教授、副教授一路晉升為傑出教授，始終深耕科學教育領域，包括TIMSS（國際數學與科學教育成就趨勢調查）的研究項目。2024年，柳教授加入澳門大學，將豐富的研究經驗及前沿理論結合，繼續投身教育研究工作。

「我喜歡做研究。」柳教授笑言：「當初學化學和教化學時，我特別喜歡做實驗，探究事物的變化。教育研究亦一樣，我喜歡探究教育發展的變化，讓學生更感興趣、更高效學習，很有趣也很有意義。」

首創在科學教育測量中應用Rasch模型

在科學教育研究領域，柳秀峰教授成果斐然，其中最突出的貢獻，當屬大力推動Rasch模型在科學教育測量中的應用。

Rasch模型由丹麥數學家Georg Rasch於1960年提出，用於評估智力與成就，透過分析答題者的整體回應來評估題目難度，同時依據他們的表現估算個人能力水平。已故芝加哥大學教育測量教授Benjamin Drake Wright將該模型引入教育測量領域，並於1969年開發了首個Rasch分析軟體BICAL，為現今廣泛使用的測量軟件奠定基礎。

Rasch模型能夠進一步延伸至測量科學教育中的學生水平，柳教授功不可沒。他與Wright教授雖不相識，但參加了其在美國教育研究協會年會上的多場演講，對該模型產生濃厚興趣。柳教授於2005年首次應用Rasch模型分析學生從小學到高中對能量概念理解的發展和變化，打破了傳統僅靠答對率評估學生能力發展變化、因缺乏共同的難度參數導致結果失真的困境，有效解決了科學教育傳統測量的弊端。翌年，他和Wright教授的學生William Boone共同編寫了《Rasch模型在科學教育中的應用》，並於2010年撰寫了《使用和開發科學教育測量工具：Rasch 模型方法》。

「Benjamin是對我的學術研究影響最大的人。科學教育研究，採用更科學的測量方法，我覺得很必要。」柳教授認真踐行這個理念，其編撰的14本學術著作中有三本與Rasch模型相關，另編輯兩卷相關的學術期刊，更就此發表近百篇期刊文章，極大地推動Rasch模型的應用。

跨學科教育的目標

柳教授鑽研的科學教育，包括化學、物理、生物、地球科學，以及近年全球關注的STEM教育，即科學（Science）、技術（Technology）、工程（Engineering）和數學（Mathematics）的跨學科教育。他圍繞STEM教育的測量評估、學生對跨學科概念的理解，以及師生STEM身份的測量和發展等進行定量研究。

他指出：「根據教育及青年發展局《綜合應用技能教育課程指引（修訂）》，至少10%的教學時間應用於綜合及應用技能學習，也就是STEM教育。這是對傳統分科學習的加強，並非為了取代個別科目，而是旨在實現超越單一學科的目標，例如解決跨學科問題。」

跨學科在新時代尤為普遍。柳教授以澳門科學館的大三巴三維展品為例，該展品由一位高中學生結合建築、電腦、歷史、藝術等多個學科知識創作，反映打破傳統學科界限對學生重新定位、提升學習自信和動能的重要性。他認為，STEM教育應形成生態系統，不局限於學校，還適用於社區、工業、企業、非政府組織、博物館等。「現實社會本就是跨學科的，當STEM教育生態和現實社會呼應，學生能更好地理解科學、技術和社會如何相互作用，提升對相關職業的興趣和能力，充分發揮個人的創造力。」

澳門科學教育潛力龐大

出任澳大教育測驗與評核研究中心主任，對柳教授意義非凡。中心的主要任務是在澳門、大灣區、中國和國際上開展大規模的教育測量和評估之研究工作，助力澳門基礎教育發展、提升整體教育質量。「其中一項工作是研究和推行PISA、TIMSS和PIRLS國際評估計劃，這些也是我一直的研究內容，期待將有關研究成果付諸實踐。於我而言既是責任，也是榮譽。」

柳教授分析：「澳門擁有非常獨特的K-12教育體

系，大部分學校是私立、社團或教會附屬學校，只有少數公立學校，沒有統一的課程和教科書，基礎教育的各階段均沒有統一考試，學校和教師有較大的教學自主權。」令人驚喜的是，澳門學生在PISA和TIMSS的數學和科學成績均躋身世界前列，而且基於社會經濟地位產生的個別差異最小，即教育公平性比其他國家和地區高。

基於此，澳門具條件強化STEM教育。「老師們不能局限自己為個別學科的老師，應重新定位為STEM老師，跨越學科限制。」柳教授指出：「澳門大學設科學教育的職前和在職培訓，不少澳門的教師和教學管理人員是澳大畢業生。相關培訓緊貼社會發展，強化跨學科概念，積極推動STEM教育的發展。此外，教育測驗與評核研究中心和學校緊密聯繫，根據學生評估結果制定具體改進計劃，這種合作模式是其他地區無可比擬的，相信有助澳門學校挖掘教學潛力。」

柳秀峰教授於2018年回到華東師範大學講學

Prof Liu returned to East China Normal University in 2018 to present a lecture

Prof Liu Xiufeng is a globally recognised leader at the forefront of education research. With over three decades dedicated to the field, he has witnessed significant technological advancements and generational changes. A firm believer in the importance of science education for social progress, he is committed to enhancing scientific literacy worldwide. Prof Liu currently serves as a chair professor in the Faculty of Education and director of the Educational Testing and Assessment Research Centre at the University of Macau (UM). He is committed to using his extensive expertise and profound insights to further the cause of education.

From Teaching to Education Research

Prof Liu's education journey began in 1978. He was among the first cohort of university students after the reinstatement of the National College Entrance Examination in mainland China. After graduation, he worked as a chemistry teacher, where he dedicated himself to improving teaching methods through hands-on practice and study. To further his knowledge, Prof Liu pursued a master's degree at East China Normal University. Upon completing his studies, he joined the Chinese National Academy of Educational Sciences (formerly known as China National Institute for Educational Research) as a research associate.

In 1989, Prof Liu began his doctoral studies at the University of British Columbia under the

柳秀峰教授出版多部學術著作

Prof Liu is the author of many academic publications

encouragement of Prof David Robitaille, the then head of the Department of Mathematics and Science Education in the university's Faculty of Education. After earning his PhD, Prof Liu held academic positions at universities in Canada and the US, where he conducted research on science education and contributed to major research projects including the Trends in International Mathematics and Science Study (TIMSS). During this time, he progressed steadily from assistant professor to associate professor, and to distinguished professor. In 2024, Prof Liu joined UM, bringing his extensive research experience and ability to combine his wealth of knowledge with cutting-edge theories.

'I love doing research,' Prof Liu says with a smile. 'When I was a chemistry student and later a chemistry teacher, I found so much joy in conducting experiments and exploring how substances change. Education research feels very similar. I am keen on studying how education evolves and finding new ways to make learning more engaging and effective for students. It is both interesting and meaningful.'

Developing Rasch Tools for Science Education

Prof Liu has made significant contributions to science education research. One of his most notable achievements is his dedicated effort to promote the use of the Rasch model for measuring science education.

The Rasch model, developed in 1960 by Danish mathematician Georg Rasch, was designed to assess intelligence and achievement. It evaluates the difficulty of test items by analysing respondents' overall answers while simultaneously estimating individual ability levels based on their performance. The late Benjamin Drake Wright, a professor of educational measurement at the University of Chicago, introduced the Rasch model to the field of educational assessment. In 1969, he developed BICAL, the first Rasch analysis software, which became the foundation for many of the measurement tools commonly used today.

Prof Liu played a pivotal role in extending the application of the Rasch model to measure student proficiency in science education. Although he never met Prof Wright personally, he attended several of his presentations at the American Educational Research Association annual meetings, which sparked his interest in the model. Inspired by Prof Wright's work, Prof Liu applied the Rasch model for the first time in 2005 to analyse how students' understanding of the concept of energy develops and changes from primary to secondary school. This approach effectively addressed the shortcomings of traditional assessment methods for science education, which relied solely on correct answer rates to measure proficiency and lacked common difficulty parameters, often leading to inaccurate results. In 2006, Prof Liu co-edited the book *Applications of Rasch measurement in science education* with William Boone, a student of Prof Wright. In 2010, he published *Using and developing measurement instruments in science education: A Rasch modeling approach*.

'Benjamin has been the most influential figure in my academic research. In science education research, using more scientific measurement methods is essential,' says Prof Liu. Guided by this philosophy, he has authored and edited 14 academic books, including three focused specifically on the Rasch model. He also serves as the editor of two science education journals and has published nearly 100 journal articles, which are instrumental in advancing the application of the Rasch model.

The Goals of Interdisciplinary Education

Prof Liu's science education research spans a wide range of disciplines, including chemistry, physics, biology, earth sciences, and STEM education. In recent years, STEM education, which integrates science, technology, engineering, and mathematics, has received growing attention. Prof Liu's work primarily focuses on quantitative research in STEM, exploring assessment methods, students' comprehension of interdisciplinary learning, and the measurement and development of STEM identities among teachers and students.

Prof Liu notes, 'According to the Curriculum Guidelines for Integrated and Applied Skills Education (Revised) issued by the Education and Youth Development Bureau of Macao, schools should allocate at least ten per cent of instructional time to integrated and applied skills learning, that is, STEM education. This approach enhances traditional subject-based teaching. Rather than replacing individual disciplines, it aims to achieve broader educational goals—for example, equipping students to solve interdisciplinary problems that transcend the boundaries of single subjects.'

柳秀峰教授出席PISA指導委員會會議

Prof Liu attends a PISA Governing Board meeting

In today's education landscape, interdisciplinary learning is increasingly common. Prof Liu uses the 3D interactive exhibits of the Ruins of St. Paul's at the Macao Science Center as an example. The exhibits, created by a secondary school student, integrate knowledge from architecture, computer science, history, and art. They show how breaking traditional subject boundaries helps students redefine their learning identities while enhancing confidence and motivation. Prof Liu believes that STEM education should work as an ecosystem and reach beyond schools to include communities, industries, businesses, NGOs, museums, and more. He explains, 'The real world is inherently interdisciplinary. If STEM education reflects the realities of society, students gain a deeper understanding of how science, technology, and society interact. This not only inspires greater interest and competence in STEM-related careers, but also unleashes students' creativity.'

Macao's Great Potential in Science Education

Serving as the director of the Educational Testing and Assessment Research Centre holds profound significance for Prof Liu. The centre's mission is to conduct large-scale educational measurement and evaluation studies in Macao, the Greater Bay Area, China, and internationally, with the goal of supporting the development of basic education in Macao and enhancing its overall education quality. Prof Liu explains, 'One of our key responsibilities is to study and implement international assessment programmes such as PISA (Programme for International Student Assessment), TIMSS (Trends in International Mathematics and Science Study), and PIRLS (Progress in International Reading Literacy Study), which are also my research areas. I look forward to putting my research findings into practice. For me, this role is both a responsibility and an honour.'

Prof Liu continues, 'Macao has a unique K to 12 education system. Most schools are private, affiliated with associations or religious institutions, with only a few public schools. There is no unified curriculum, standardised textbooks, or centralised exams at any stage of basic education. Schools and teachers enjoy considerable autonomy in their teaching.' Surprisingly, despite this decentralised structure, Macao students consistently rank among the world's top performers in math and science in PISA and TIMSS assessments. Moreover, the achievement gaps related to socioeconomic status are among the smallest globally, reflecting higher educational equity compared to other countries and regions.

With these strong foundations, Macao has significant potential to strengthen STEM education. 'Teachers should no longer view themselves only as subject-specific instructors but should instead reimagine their roles as STEM educators who can break down subject boundaries,' Prof Liu explains. 'The University of Macau offers both pre-service and in-service training in science education, and many of the teachers and administrators in Macao's schools are UM graduates. In line with social development, our training programmes emphasise interdisciplinary concepts and actively promote STEM education. Moreover, our centre works closely with schools. It uses their student assessment data to develop customised improvement plans. This collaboration approach sets Macao apart from other regions and, in my opinion, will help Macao's schools reach their full educational potential.'

Enhancing Scientific Literacy Worldwide

Prof Liu emphasises, 'Many people think that the purpose of science education is to cultivate professional scientists and drive technological progress. However, I believe that the ultimate goal of science education is to develop scientific literacy in every individual. Whether someone attends university,

柳秀峰教授於澳大「科技素養國際研討會」上分享

Prof Liu speaks at the International Symposium on STEM Literacy held at UM

studies science or engineering, or pursues the arts, scientific literacy is essential. It is not just about learning foundational science knowledge; it is about adopting a data-driven mindset for making informed decisions.' This belief about science education has deeply influenced Prof Liu's educational journey. From his early career as a secondary school teacher, inspired by underprivileged students who transformed their lives through hard work, to his current role as a university professor reimagining science education, Prof Liu remains dedicated to challenging traditional teaching methods and reshaping educational practices. His mission is to elevate the role of science education, ensuring that more students can benefit from its lifelong benefits.

柳秀峰是澳門大學教育學院講座教授、教育測驗與評核研究中心主任，加拿大聖弗朗西斯·格扎維埃大學和愛德華王子島大學終身教授，美國紐約州立大學布法羅分校科學教育傑出教授，中國基礎教育質量監測協同創新中心主任顧問，美國科學促進會（AAAS）會士。其以概念學習與轉變、技術與學科教育的整合以及教育測量與評價等研究著稱，在國際知名期刊發表論文近百篇，現擔任《科學教學研究》雜誌副主編、《學科與跨學科科學教育研究》雜誌聯合主編。

Liu Xiufeng is a chair professor in the Faculty of Education and director of the Educational Testing and Assessment Research Centre at the University of Macau. Prior to joining UM, he was a tenured faculty member at St. Francis Xavier University and the University of Prince Edward Island in Canada; and a SUNY Distinguished Professor of Science Education in the Graduate School of Education, University at Buffalo, State University of New York. In addition, Prof Liu serves as a chief consultant to the Collaborative Innovation Center of Assessment for Basic Education Quality in China, and is a fellow of the American Association for the Advancement of Science. Prof Liu is internationally recognised for his contributions to science education, particularly in the areas of conceptual learning and change, the integration of technology and disciplinary education, as well as educational measurement and evaluation. He has published extensively, with nearly 100 articles appearing in leading international journals. Currently, Prof Liu serves as an associate editor of *Journal of Research in Science Teaching* and a co-editor-in-chief of *Disciplinary and Interdisciplinary Science Education Research*.

意識解碼：
Michiel Spapé教授的人機共生研究

Deciphering Consciousness: Prof Michiel Spapé's Research on Human-Computer Symbiosis

文：余偉業｜圖：蔡俊祥，部分由受訪者提供｜英文翻譯：余偉業、謝菀菁
Text: Kelvin U｜Photo: Hasen Cai, with some provided by the interviewee｜English Translation: Kelvin U, Bess Che

對全身癱瘓的患者而言，這是最殘酷的困境——清醒的意識被困在無法動彈的軀體中。如今的腦機交互（Brain-Computer Interface，簡稱BCI）技術，就像一台需要複雜指令的機器：患者須刻意想著「移動右手手指」，系統才能辨識並轉化為機械義肢的動作。但如果我們能繞過繁瑣的「意識指令」，直接解讀大腦深處最原始的意圖信號呢？

這正是澳門大學認知與腦科學研究中心副教授Michiel Spapé正在推動的BCI前沿研究。與傳統BCI技術截然不同的是，這項研究不再要求用家在腦海重覆動作指令，而是直擊人類意識的核心，即解碼大腦的原始動機——例如從杯子中飲水的慾望，而非完成飲水所需的肌肉運動。這項研究將塑造人機互動的未來，只需「想要」就能操控智能設備，為「意念即指令」的BCI新時代鋪路。

攻關腦機交互的根本難題

Michiel Spapé教授一直試圖攻克一個重要的謎題：如何將主觀的「意識」，轉化為可解碼的科學語言？現有的BCI技術是通過檢測大腦活動產生的電信號，將其轉化為電腦能夠理解的指令，實現大腦對外部設備的控制。這項技術雖然能解讀人類意念，但實際應用中存在明顯的不自然。

Spapé教授以「飲水」這個日常動作為例：人腦在執行「拿起水杯」這簡單的動作時，能無意識地流暢整合舉臂、前伸、握取等細微指令，猶如呼吸般自然。然而現有BCI卻反其道而行，硬生生將這串一氣呵成的連貫動作，拆解成「先想像舉臂高度，再計算前伸距離，最後模擬五指握姿」等繁瑣的意識指令。這種「分解式操作」既違背大腦本能，更讓簡單的動作變得費神。「怎樣令操作像呼吸一樣自然？」在澳大認知與腦科學研究中心裡，Spapé教授正引領團隊攻克這道「卡脖子」難題，推進「意念」控制機器的技術向前。

經過不懈努力，Spapé教授與團隊成功開發出基於「神經適應模型」的雙向BCI系統。這項技術能夠即時分析大腦活動，精準判讀使用者當下的動機與情緒狀態，並據此執行相應動作或實現更高層次的互動。透過整合「生成式人工智慧」的學習與訓練能力，該系統可以解讀我們對不同刺激的本能反應，從而實現遠超傳統單純動作控制的先進腦控互動體驗。

Spapé教授團隊正在開發的「AI導師」系統便是該研究的其中一項應用。此系統結合「神經適應建模」與「多模態情感AI」，並搭載基於Deepseek技術的AI代理，扮演教學輔助角色。透過分析學生的面部表情、語音語調及腦電圖數據，捕捉其大腦釋放的意識信號，即時判斷其挫折感、專注度及頓悟時刻等情感狀態關鍵指標。當系統檢測到挫敗感或興趣下降時，就表示需要調整教學策略。例如簡化材料或者重覆關鍵概念。這項技術有望顯著提升學習成效，特別適用於遠程學習情境與自主學習階段。

「這就像跳探戈一樣，」Spapé教授形象地比喻，「理想的互動應該是雙方默契配合，而非一方生硬地跟隨指令。我們致力為腦機介面創造一種嶄新的溝通方式。」

捕捉大腦的「第一人稱體驗」

Spapé教授研究的核心目標，在於推動BCI系統突破單純動作解碼的局限，進一步捕捉行為背後的動機維度——即人們真正的慾望本質，以及執行動作時的主觀感受。這項研究奠基於認知科學的重要發現：自然行為源自「感知—動作—情感」的整合循環，而非孤立的運動指令。傳統BCI系統往往將大腦視為「生物遙控器」，僅將神經訊號轉譯為單向指令（例如「將機械手臂移向杯子」），卻忽略了情感回饋，如觸碰燙手杯子時的退縮衝動，或是穩握物品時的滿足感。

要真正模擬這循環，Spapé教授強調BCI技術須突破現有範式。新一代BCI不僅需要解讀運動指令，更須捕捉大腦的「第一人稱體驗」，也就是構成人類意識基礎的主觀感受，例如看到紅色時「覺得鮮豔」的視覺體驗、被針刺到「感到痛」的觸覺、聞到咖啡香時「喚起記憶」的聯想。

Spapé教授解釋，想像你向天生失明人士描述「紅色」，但無法傳達「紅的感覺」——這正是「第一人稱體驗」的不可替代性，更是對意識科學的挑戰：如何將第一人稱主觀與第三人稱客觀這兩種視角結合，以真正理解「意識」從大腦中湧現。目前，他和團隊正努力透過實驗，將主觀的「第一人稱體驗」轉化為可量化的數據，並與大腦活動對應，推論哪些大腦機制能產生特定的意識體驗。

為腦科學研究注入新動力

Spapé教授於2023年加入澳大，擔任認知與腦科學研究中心副教授，他不僅為澳大帶來前沿的腦科學研究視野，更以其獨特的跨學科背景為「認知神經科學碩士課程」注入創新活力，將其在心理學、神經科學、計算機科學等豐富而全面的知識傳授予學生。

Spapé教授的跨學科的專業造詣，源於永不滿足的求知慾與突破傳統學術疆界的決心。最初專攻認知心理學的他，很快便被人類心智深層的複雜性所吸引。回顧求學歷程，他分享道：「最初我只是個對人類心智著迷的心理系學生。但在荷蘭萊頓大學攻讀博士期間，當我第一次看見並理解腦電圖（EEG）那些雜亂波動的腦波線條時，彷彿大腦正對我低語它的秘密。」

這番頓悟徹底改變了Spapé教授的學術軌跡，也深化了他對神經科學的投入。博士畢業後，他前往英國諾丁漢大學從事博士後研究，專注於運動控制的電生理學機制。期間，他深入鑽研信號處理技術，沉浸於神經元與

神經回路的世界中。隨後四年，他在芬蘭赫爾辛基信息技術研究所任職，研究電腦媒介觸覺技術，並與頂尖電腦科學家展開合作。

這段學術探索之旅讓Spapé教授有了更深刻的體悟：「我的學術本質始終是心理學。我真正渴望理解的，是心智（mind）運作的奧秘，而不僅是大腦的生理機制。」這牽引正是他先後回到利物浦大學、赫爾辛基大學心理學系任教。對他而言，神經科學是揭開心智奧秘的精密儀器，電腦科學則是模擬它的強大工具。「但若要推動真正的變革，關鍵在於建立心理學與科技間平等對話的夥伴關係——讓技術為人文服務。」

多年來，Spapé教授始終致力於跨學科合作，與電腦科學家及工程師緊密配合以實現研究突破。如今在澳大，他充分運用其歐洲學術網絡，拓展學生的國際研究視野。其中一項他幽默稱為「間諜對間諜行動」，便是定期安排其學生與赫爾辛基的研究夥伴進行線上會議，促進深度的跨境學術協作。

「學術合作的本質，在於建立持久的對話橋樑。學生不僅能了解其他國家的研究模式，並從中提升英語溝通能力。更多時候，這些交流會激發新想法，促成新合作。就在上個月，我們與芬蘭學者舉行了一場富有成效的線上會議，共同優化多項聯合研究計劃。」

讓科技成為身體的一部分

在實驗室中，Spapé教授與團隊正致力於將大腦的「主觀意識」轉化為可操控的機械動作，更深入而言，是聚焦於如何讓機器真正理解「觸覺反饋」的細微差異。「這項基礎研究將為人機互動開創全新可能，對未來智能肢體輔具發展具有革命性意義。」Spapé教授表示，「或許不久的將來，科技將不再只是冰冷的工具，而能真正成為身體的自然延伸。」

捕捉大腦「意識」，開啟腦機交互的新局面，是一條極具挑戰的道路，Spapé教授如同他所敬重的2024年諾貝爾物理學獎得主、認知心理學家Geoffrey Hinton教授一樣，始終對人工神經網路與機器學習領域滿懷熱忱，他將繼續深耕「意識」難題，重塑人機對話本質。「我希望在這條路上留下自己的足跡，用突破性的發現，為人機共生的新紀元奠定理論基礎與技術基石。」

Michiel Spapé教授
Prof Michiel Spapé

Imagine being paralysed from the neck down and unable to move or speak—yet still fully capable of thought. Today's brain-computer interfaces (BCIs) can translate specific mental commands, such as 'move my right finger', into actions, allowing patients to control robotic limbs or type messages using only their thoughts. But what if we could bypass these mental steps entirely?

This is the focus of the cutting-edge research of Michiel Spapé, associate professor in the Centre for Cognitive and Brain Sciences (CCBS) at the University of Macau (UM). Unlike traditional BCIs, which require users to mentally simulate step-by-step movements, Prof Spapé's team investigates how the brain encodes motivations—for example, the desire to drink from a cup—without focusing on the muscle movements needed to accomplish the task. Their work holds the potential to create a future where even healthy individuals can control technology effortlessly through pure intention, blurring the line between mind and machine.

Tackling the Fundamental Challenges in BCI Technology

Prof Spapé has long been driven by a profound question: How can we translate subjective human consciousness into a form that machines can understand? Current BCI technology works by detecting electrical signals generated by brain activity and converting them into commands that computers can interpret, enabling the brain to control external devices. However, despite these advancements, the technology often feels unnatural in real-world use.

Prof Spapé uses a simple example to explain this challenge. When we pick up a teacup, our brain naturally and effortlessly generates a smooth sequence of motor commands, much like breathing. Existing BCI systems, however, require users to break this action into a series of deliberate mental steps. To lift a teacup, a person must first imagine raising their arm, then moving it forward, and finally gripping the handle with precise finger movements. This rigid, step-by-step process makes interactions feel awkward and counterintuitive. Prof Spapé asks: 'How can we make these commands as natural as breathing, without requiring conscious effort?' In CCBS, he is leading his team to answer this question. They are dedicated to overcoming this bottleneck by creating BCIs that enable seamless and intuitive interactions between the brain and external devices.

Through relentless effort, Prof Spapé's team has developed a bidirectional BCI system powered by neuroadaptive modelling. This advanced technology uses real-time brain activity analysis to determine ongoing motivations and emotions, and uses this information to perform actions or higher-level interactions. For example, by integrating the learning and training capabilities of generative AI, the system can interpret how we respond intuitively to different stimuli, allowing for far more advanced brain control than simply movements.

A notable application of this technology is the 'AI Tutor' system, which Prof Spapé's team is currently developing. This system combines neuroadaptive modelling with multimodal emotional AI, and features a Deepseek-based artificial agent that acts as a tutor. The AI Tutor assesses students' emotional states by analysing their micro facial expressions, speech prosody, and real-time electroencephalography (EEG) data. Using this information, it can control teaching strategies to better suit individual learners. Specifically, the AI Tutor identifies emotional indicators that are essential for motivation and learning, including frustration intensity, attentional engagement, and moments of sudden insight. For example, if the system detects a student's frustration with the learning materials or a decline in interest, it signals the need to adjust teaching strategies, such as by simplifying the material or repeating key concepts. This technology has the potential to significantly enhance learning effectiveness, particularly in distance learning scenarios and during study sessions.

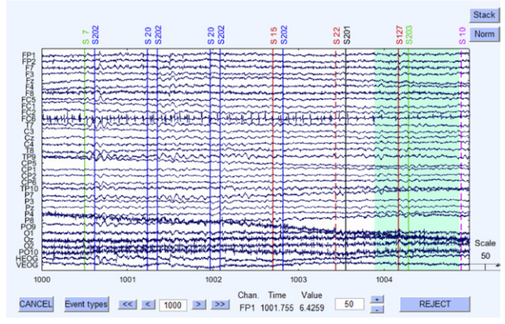
Michiel Spapé教授合著書籍及學術專著
Prof Michiel Spapé's co-authored book and academic monograph

'It's like the difference between a choreographed routine and an improvised dance,' explains Prof Spapé. 'Current BCIs force the brain to follow pre-set commands, whereas we're developing technology that enables genuine neural dialogue—where both systems adapt to each other in real time.'

Capturing the Brain's 'First-Person Experience'

A central focus of Prof Spapé's research involves advancing BCI systems beyond simple movement decoding to capturing the motivational dimension of actions—what a person truly desires and how it feels to perform an action. This work builds on a fundamental insight from cognitive science:

Michiel Spapé教授與研究團隊
Prof Michiel Spapé with his research team



Michiel Spapé教授研究的腦電圖數據
EEG data from Prof Michiel Spapé's research

natural behaviour emerges from integrated perception-action-emotion loops, not just isolated motor commands. Traditional BCIs often treat the brain as a 'biological remote control', translating neural signals into one-way commands, such as 'move robotic arm to cup'. However, such systems fail to capture the first-person experience—the emotional feedback that shapes intentions, like the urge to withdraw from a hot cup or the satisfaction of a firm grip. Prof Spapé's approach prioritises decoding these affective states to create BCIs that understand not just *what* someone is doing, but *why* they want to do it, closing the loop between desire, action, and emotional consequence.

To truly replicate the cycle, Prof Spapé emphasises that BCI technology must advance beyond its current paradigm. Next-generation BCIs must not only decode motor commands but also capture the brain's first-person experience—the subjective sensations and perceptions that form the foundation of human consciousness. Achieving this requires neurophenomenology decoding, which links neural activity to subjective experiences such as the vividness of seeing the colour red, the sharp sting of a pinprick, and the nostalgic memory evoked by the smell of coffee.

Prof Spapé explains the complexity of this challenge: 'Imagine trying to describe the colour red to someone born blind. You can outline its wavelengths and associations, but you can never truly convey the experience of seeing red.' This highlights the irreplaceable nature of first-person experience and poses a fundamental challenge in consciousness science: how to bridge the explanatory gap between subjective phenomenology (what it feels like) and objective neurobiology (what physically occurs) to truly understand how consciousness emerges from neural processes. To tackle this issue, Prof Spapé and his team are conducting experiments to translate subjective first-person experiences into quantifiable data. By correlating these experiences with brain activity, they aim to identify the neural mechanisms responsible for generating specific conscious experiences.

Injecting New Momentum into Neuroscience Research

Prof Spapé joined UM in 2023 as an associate professor at the Centre for Cognitive and Brain Sciences. Along with bringing cutting-edge perspectives to brain science research, his unique interdisciplinary background has also infused innovative momentum into the UM master's programme in cognitive neuroscience, where he integrates his expertise in cognitive psychology, neurotechnology, and computer science.

Prof Spapé's multidisciplinary expertise comes from an insatiable intellectual curiosity and a determination to push beyond traditional academic boundaries. Originally specialising in cognitive psychology, he quickly became captivated by the deeper complexities of the human mind. Reflecting on his educational journey, he shares, 'I started as just a psychology student fascinated by the human mind. But during my PhD at Leiden University in the Netherlands, the first time I saw and understood EEG brainwaves—those messy, jiggly lines—it felt like the brain was whispering its secrets to me.'

This revelation reshaped Prof Spapé's academic journey and deepened his commitment to neuroscience. After completing his studies at Leiden University, he pursued postdoctoral research at the University of Nottingham in the UK, where he focused on the electrophysiology of motor control. There, he delved into signal processing and immersed himself in the world of neurons and circuits. He then spent four years at the Helsinki Institute for Information Technology in Finland, studying computer-mediated touch while collaborating with leading experts in computer science. However, along the way, Prof Spapé had a profound realisation. 'At heart, I've always been a psychologist. I want to understand how the mind works, not just the brain,' he reflects. 'That's why I eventually returned to psychology departments, first in Liverpool and later in Helsinki. To me, neuroscience and computer science are critical tools to uncover the mysteries of the mind. But to make a global impact, there needs to be an equal partnership between psychology and technology.'

Throughout his career, Prof Spapé has been dedicated to interdisciplinary collaboration, working closely with computer scientists and engineers to achieve research breakthroughs. Now at UM, he leverages his European academic network to broaden students' international research perspectives. One of his initiatives—which he humorously refers to as his 'spy-vs-spy operation'—involves arranging regular online meetings between his students and their counterparts in Helsinki, fostering meaningful cross-border collaboration.

'It's about keeping communication channels open,' Prof Spapé explains. 'At the very least, students learn how research works in other countries and improve their English communication skills. But more often, these exchanges spark new ideas and lead to collaborative projects. Just last month, we held a productive online session with Finnish scholars to optimise some joint research initiatives.'

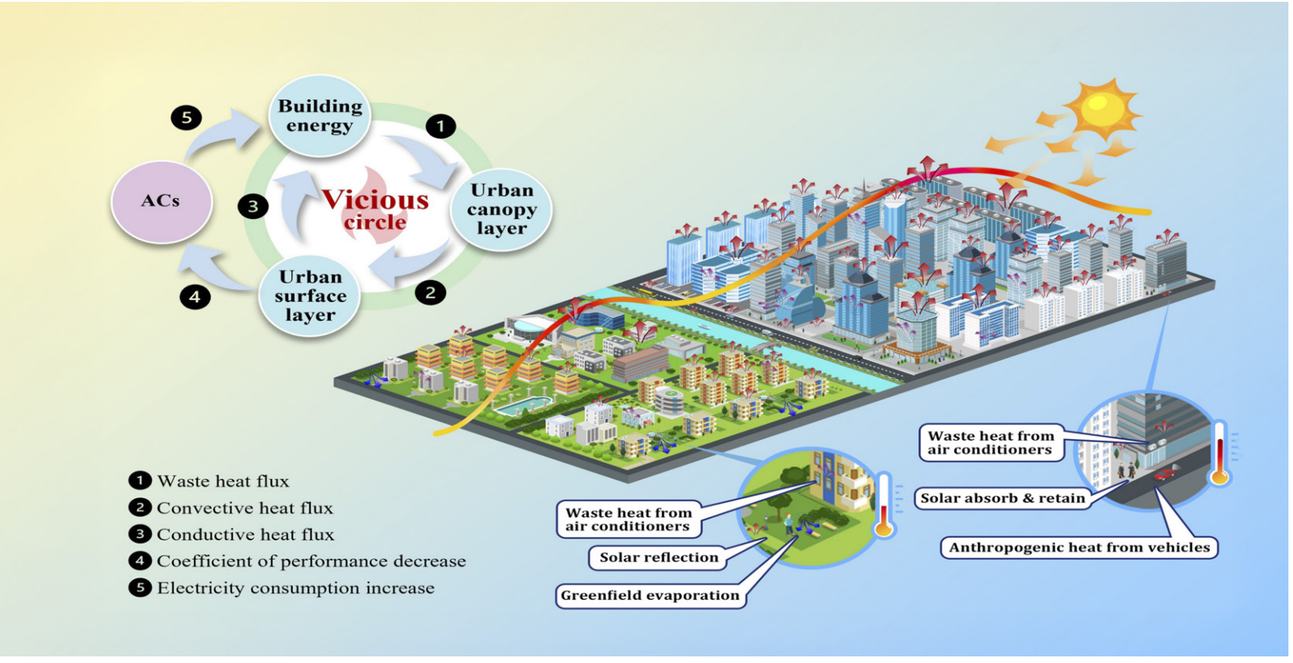
Making Technology an Extension of the Body

Prof Spapé and his team are working to translate the brain's subjective consciousness into controllable actions. More specifically, their work focuses on teaching machines to truly understand the nuances of tactile feedback. 'This foundational research will open up new possibilities for human-machine interaction and has game-changing implications for the future of smart prosthetic limbs and remote collaboration,' Prof Spapé explains. 'Perhaps in the near future, technology will no longer feel like a separate, external device, but instead function as a natural extension of the human body.'

Deciphering the brain's consciousness to redefine brain-computer interaction is an extremely challenging pursuit. Inspired by the cognitive psychologist Prof Geoffrey Hinton, the 2024 Nobel laureate in physics, whom he deeply admires, Prof Spapé remains passionate about artificial neural networks and machine learning. He is committed to unravelling the mysteries of consciousness to fundamentally reshape the ways humans and machines interact. 'I hope to leave my mark on this journey. Through groundbreaking discoveries, my goal is to establish the theoretical and technological foundations for a new era of human-machine symbiosis.'

Michiel Spapé是澳門大學科技學院副教授、協同創新研究院認知與腦科學研究中心副教授，於荷蘭萊頓大學獲得心理學博士學位，隨後分別在英國諾丁漢大學、芬蘭赫爾辛基資訊技術研究所、英國利物浦希望大學，以及芬蘭赫爾辛基大學從事大腦與意識研究。曾撰寫或合著74篇同行評審文章、兩本教科書和一項專利，並擔任*Psychological Research*和*Frontiers in Psychology: Cognition*的副編輯。

Michiel Spapé is an associate professor in the Centre for Cognitive and Brain Sciences and the Faculty of Science and Technology at the University of Macau. He obtained his PhD in psychology from Leiden University in the Netherlands and went on to conduct research on the brain and mind at the University of Nottingham in the UK, the Helsinki Institute for Information Technology in Finland, Liverpool Hope University in the UK, and the University of Helsinki in Finland. He has published 74 peer-reviewed articles, authored two textbooks, and holds a patent. Prof Spapé also serves as an associate editor of *Psychological Research* and *Frontiers in Psychology: Cognition*.



城市空間內微氣象、能源系統與建築部門之間存在惡性循環關係

The vicious cycle between urban microclimates, energy systems, and building sectors

智慧城市建設的跨學科合作視角：城市微氣象、城市能源系統與城市建築部門

Interdisciplinary Collaboration Perspectives for Smart City Development: Urban Microclimates, Energy Systems, and Building Sectors

文、圖：宋永華、張振威、惠紅勛｜英文翻譯：葉浩男

Text & Photo: Yonghua Song, Zhang Zhenwei, Hui Hongxun | English Translation: Davis Ip

隨著全球暖化與城市化持續演進，不合理的城市建設與能源消費，使全球的城市面臨極端氣候與能源安全風險，陷入環境惡化與能源消耗不斷攀升的惡性循環。要實現智慧城市的高效、韌性和可持續發展，跨學科合作是必由之路，至關重要。

城市系統之間惡性互動的挑戰

城市微氣象、能源系統與建築部門是城市經濟與社會活動的基本載體。但只要其中一個系統的建設與運行管理不當，便可能引起其它系統的連鎖惡化。

這個問題會加劇城市的能源消耗與碳排放，例如密集的建築群容易引發城市熱島效應，過熱的天氣又會增加製冷需求。同時，空調設備的大量運行所排放的廢熱則會進一步抬升城市氣溫。此外，城市微氣象的惡化（如溫度升高、濕度變化、污染物增加、降水異常），和不合理的建築設計與營運，均會直接加重城市能源系統的負擔。

另一方面，這個問題也會使城市的健康與可持續發展面臨更大的挑戰。在建造、運營、維護和回收的全生命環節中，城市能源系統與建築部門均會直接或間接影響城市氣象系統。不合理的建築群設計與污染物排放可能會引發城市熱島效應、雨島效應、風島效應與污染島效應，進而在城市內部形成典型的微氣象問題區域。

此外，城市系統之間的惡性互動也會進一步加劇對城市韌性與可靠性管理方面的挑戰。由於城市氣象系統、能源系統與建築部門之間緊密互動，單一系統出現的風險與故障，可能會在多個系統之間傳遞和疊加。特別是在依賴高度集中化供能系統且擁有密集建築群的城市街區中，熱浪、內澇和颱風等災害會嚴重威脅能源系統的安全，並可能引發建築群內的連鎖故障。

推動跨區域協作

城市內的微氣候與能源系統，通常會因建築集群的分佈而呈現出明顯的分區特徵。不同區塊在建築功能、能源使用行為和微氣候特徵方面的差異，讓利用跨區域協作來應對共同風險成為可能。尤其值得注意的是，區域能源系統在供能類型、網架結構和負荷特徵具有明顯的互補性，能夠透過跨區域協作來增強能源系統的靈活性。

開發新興技術和方法

物聯網、大數據、人工智能等技術的發展，為學科交叉合作提供新的機遇。基於傳感與通信網路的數位孿生系統，為能源系統和建築部門提供了更智能、透明的管理平台；同時，先進材料與新型能源的研發，為解決學科交叉合作中的難題提供了創新的手段，例如將綠色相變材料與可持續冷卻技術用於建築設計中，能有助於緩解城市微氣候的惡化。

有效的政策引導

政策引導是推動城市中不同學科研究者跨領域合作的重要催化劑。政策能有效打破跨學科研究的利益衝突與知識壁壘、構建統一的信息共享與交流平台，並且形成長期可持續發展的目標引導與約束機制。同時，完善的政策能減少學科交叉合作時可能引發的社會資源分配不公、經濟不等和健康風險等潛在問題。

關注長期規劃

面對全球氣候持續變化，城市的規劃、建設、運營和管理需要更多具前瞻性的方法。未來的智慧建築將更加注重模組化、靈活性和智慧化，為居民提供更高效、舒適且可持續的生活環境。同時，智慧能源系統的發展將會更加注重區域分散自治、交直流混聯、高比例新能源集成和高效的需求側響應，從而實現更低碳和可靠的能源供應。

Challenges in Urban System Interconnections

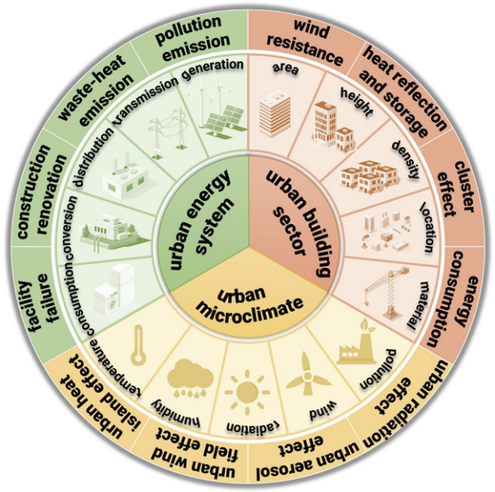
As global warming intensifies and urbanisation accelerates, unsustainable urban growth and excessive energy use are heightening the risks of extreme climate events and energy insecurity in cities, creating a harmful cycle of environmental degradation and increasing energy demands. To break this cycle and foster the development of efficient, resilient, and sustainable smart cities, interdisciplinary collaboration is essential.

Urban microclimates, energy systems, and building sectors are crucial for maintaining economic and social activities in cities. However, shortcomings in the design, operation, or management of any one of these areas can ripple through interconnected urban networks, causing widespread disruptions.

This problem can significantly increase a city's energy consumption and carbon emissions. For example, dense clusters of urban buildings can intensify the urban heat island effect, driving up cooling demands. The waste heat released from air conditioning systems further raises temperatures. Moreover, worsening urban microclimates—characterised by changes in temperature, humidity, pollution, and precipitation—along with inefficient building designs and operations, place even greater strain on energy systems.

These dynamics also pose bigger challenges to urban health and sustainability. The lifecycles of urban energy systems and building sectors—from construction to operation, maintenance, and recycling—affect urban meteorology directly and indirectly. Poorly designed building clusters and emissions intensify phenomena such as urban heat islands, rain islands, wind islands, and pollution islands, leading to distinct and increasingly problematic microclimates in a city.

These harmful interactions further challenge urban resilience and reliability. The close interdependence between urban meteorological systems, energy networks, and the building sector means that risks or failures in one area can cascade into the others. In particular, in areas with dense building clusters and a reliance on centralised energy systems, extreme weather events like heatwaves, urban flooding, or typhoons can severely compromise energy security and may trigger widespread failures across the closely packed building clusters.



熱排放、污染與能源消耗等因素與建築特性及城市氣象條件產生相互作用，進而形成一個影響城市可持續發展與韌性的複雜依存網絡。

Factors such as heat emissions, pollution, and energy consumption interact with building characteristics and urban meteorological conditions, forming a complex web of interdependencies that shape sustainability and resilience in cities.

Emerging Technologies and Methods

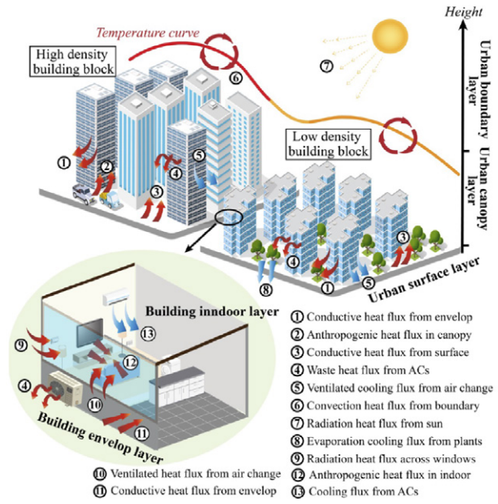
Advancements in technologies such as the Internet of Things (IoT), big data, and artificial intelligence (AI) are revolutionising interdisciplinary collaboration. For example, digital twin systems, powered by sensor and communication technologies, enable smarter and more transparent management platforms for energy systems and building sectors. Meanwhile, advancements in materials science and new energy sources are helping to address challenges in cross-disciplinary efforts. For instance, using green phase-change materials and sustainable cooling technologies in building designs can help mitigate urban microclimate deterioration.

Effective Policy Guidance

Policy initiatives are key to promoting interdisciplinary collaboration among urban researchers. They play a vital role in resolving conflicts of interest, bridging knowledge gaps between disciplines, establishing unified information-sharing platforms, and building guidance and regulatory frameworks to support long-term sustainable development goals. Moreover, well-designed policies can help reduce social and economic inequalities as well as health risks that can arise from interdisciplinary initiatives.

Long-Term Planning

As global climate change accelerates, it is necessary to adopt more forward-thinking strategies in urban planning, construction, and management. The next generation of smart buildings will emphasise modularity, flexibility, and intelligence, aiming to build living environments that are not only efficient but also comfortable and sustainable. At the same time, smart energy systems will place more emphasis on decentralised regional autonomy, hybrid AC/DC networks, renewable energy integration, and demand-side efficiency, together paving the way for a low-carbon and reliable energy future.



城市微氣象與建築用能需求互動機理

The interaction mechanism between urban microclimates and building power demands

宋永華是澳門大學校長、智慧城市物聯網國家重點實驗室主任及電氣工程講座教授，英國皇家工程院院士，歐洲科學院（外籍）院士，國際電氣與電子工程師學會（IEEE）會士。他於1989年在中國電力科學研究院獲博士學位，長期從事電力系統分析與控制研究，在電力系統安全高效低碳運行方面做出了系統性、創造性的貢獻。

Yonghua Song is the rector of the University of Macau (UM), director of the State Key Laboratory of Internet of Things for Smart City, and a chair professor in electrical engineering at UM. He is also a Fellow of the Royal Academy of Engineering in the UK, a member of Academia Europaea and a Fellow of the Institute of Electrical and Electronics Engineers (IEEE). Rector Song obtained his PhD from the China Electric Power Research Institute in 1989. As an internationally renowned scholar, he has dedicated his career to research on power system analysis and control, making systematic and innovative contributions to the safe, efficient, and low-carbon operation of power systems.

張振威是澳門大學智慧城市物聯網國家重點實驗室的電機及電腦工程博士生，2022年獲得山東大學電氣工程碩士學位，主要研究城市綜合能源系統的優化技術，領域包括分散式能源、靈活負載及微氣候的影響等。

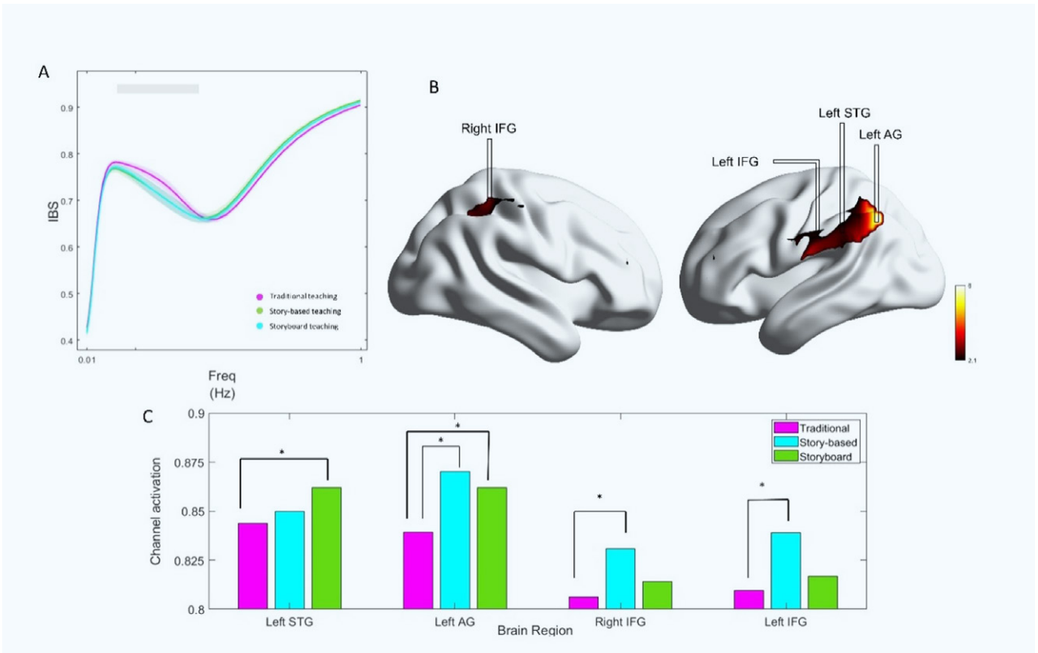
Zhang Zhenwei is a doctoral student in electrical and computer engineering at the State Key Laboratory of Internet of Things for Smart City at UM. He earned his master's degree in electrical engineering from Shandong University in 2022. His research focuses on the optimisation of urban integrated energy systems, with a focus on distributed resources, flexible loads, and microclimates.

惠紅勛是澳門大學智慧城市物聯網國家重點實驗室助理教授，2020年獲浙江大學電機工程博士學位。他的研究領域涵蓋智慧能源的運行優化、物聯網技術、電力經濟與碳市場、能源與環境交叉學科等。

Hui Hongxun is an assistant professor at the State Key Laboratory of Internet of Things for Smart City at UM. He obtained his PhD in electrical engineering from Zhejiang University in 2020. His research focuses on the optimal operation of energy systems, Internet of Things technologies for smart energy, power system economics and carbon markets, and interdisciplinary studies on energy and the environment.

「學術研究」為投稿欄目，內容僅代表作者個人意見。

Academic Research is a contribution column. The views expressed are solely those of the author(s).



研究不同教學方法如何影響師生之間的大腦同步程度的實驗結果

The results of the study examining how different teaching methods influence the level of brain synchrony between students and teachers

利用fNIRS超掃描技術研究大腦同步對兒童學習與發展的影響

Exploring Brain Synchronisation in Children's Learning and Development With fNIRS Hyperscanning

文、圖：張娟、王一暉

Text & Photo: Zhang Juan, Kira Wang Yihui

近年來，兒童發展與早期教育研究的焦點逐漸從學業和發育成果的測量轉向對學習與發展過程的探討。許多心理學理論（如維果茨基的社會文化理論、布朗芬布倫納的生態系統理論）皆將社交互動視為兒童學習與發展的核心。透過剖析這些互動過程中的心理機制，我們能更深入理解其在兒童學習與發展中所扮演的角色，同時研究大腦如何處理學習與社交互動。這些大腦神經現象不僅能為心理學理論提供實證支持，還有助於識別互動相關的神經傳導路徑，進而有針對性地開發和制定有效的教育策略與介入措施，促進兒童發展。

大腦同步與教育成效

近年來，科學家運用功能性近紅外光譜（fNIRS）超掃描等先進神經影像技術，研究大腦同步（又稱腦間同步）現象對教育與家庭互動的影響。大腦同步是指兩個或多個個體（如學生與教師）在社交互動時，他們的大腦特定區域會呈現顯著的同步激活模式，即「腦間神經耦合」的現象。

我們的研究團隊近期運用fNIRS超掃描技術，實時觀測兒童與成人在學習與家庭互動中的大腦活動，藉此探討大腦同步在兒童與社會環境互動中的作用。研究結果顯示，改進教學與育兒方式能在神經層面有效促進兒童的學習和成長，而大腦同步現象則是評估兒童與社會環境互動質量的重要指標。

以故事為基礎的教學：透過大腦同步提升STEM學習成效

STEM（科學、技術、工程與數學）教育對兒童的學術發展至關重要，但如何找到最佳的教學方法始終是一大挑戰。在STEM教育場景中，我們分別運用了傳統授課和更具吸引力的創意教學法（運用繪本講故事法以及運用故事板講故事法），研究這三種方法如何影響學生在學習STEM學科時與教師之間的大腦同步現象。

研究結果顯示，相比傳統授課方式，以講故事為基礎的教學能顯著提升大腦左右兩側額下回（一個關於語言與資訊處理的區域）之間的同步性。具有敘事結構且能引起情感共鳴的故事教學，似乎有助加強師生之間的大腦同步。此外，在採用故事板教學時，師生之間的顳上回（一個關於聲音與視覺資訊處理的區域）同步性明顯提升，顯示故事板等視覺化敘事工具能有效促進大腦對STEM概念的理解與記憶。

這個研究最有趣的發現之一，或許是大腦同步與學習成果之間的密切聯繫。在以故事為基礎的教學中，師生之間在大腦左側緣上回（一個負責處理和理解感官資訊的關鍵區域）同步程度顯著提升，而這一同步程度與學生在STEM學科的學習成效呈現高度正相關。由此可見，教師與學生之間的大腦同步程度不僅彰顯了師生溝通交流的效率，也是一項衡量學習成效的重要指標。這一發現不僅揭示了學習過程中的關鍵機制，也為優化課堂教學提供了新的可能性。

家庭互動如何影響兒童發展

在另一項研究中，我們觀察了47對母女在完成拼圖任務時的表現，探討母親在評價孩子行為時給予的正面與負面反饋如何影響母女之間的大腦同步程度，進一步了解兒童與家長互動時的大腦反應。

研究結果顯示，當母親給予負面反饋時，母女之間在大腦左背外側前額葉皮質（dlPFC）與右額下回（IFG）等關鍵區域的同步程度顯著降低，而這些大腦區域在情緒管理與社交互動中扮演重要角色。換言之，負面反饋可能會削弱兒童處理與應對情感經驗的能力。相較之下，正面反饋能顯著提升母女在上述大腦區域的同步程度，顯示具鼓勵性的反饋有助於母女在互動過程中理解彼此。

我們還發現，在以「服從型溝通模式」（即僵化且帶有權威性的溝通方式）為主的家庭中，母女之間在與情緒調節、語言處理相關的大腦區域的同步程度較低。相反，在較為開放、重視互動的溝通模式下，母女之間的大腦同步程度較高，顯示家庭中溫和且靈活的溝通方式更有助於兒童的情感與認知發展。

值得注意的是，情感韌性較高的兒童即使收到負面反饋，仍能與母親保持較高程度的大腦同步。這顯示情感韌性在神經層面發揮了緩衝作用，有助於減輕批評帶來的負面影響，並提升兒童在處理資訊與調節情緒方面的適應能力。

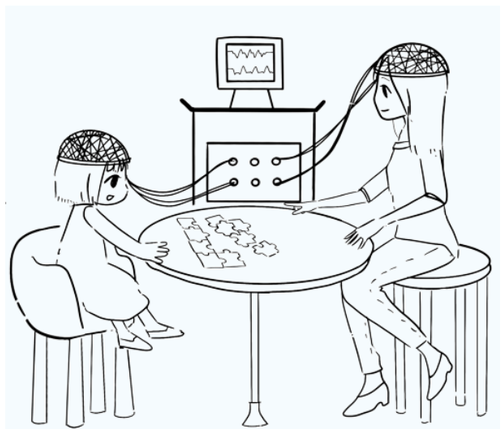
銜接科學與實踐

透過先進的fNIRS超掃描技術，我們的研究證實，大腦同步程度與學習表現及情感發展密切相關，在學校或家庭環境中皆是如此。對教育工作者而言，採用更具創意與吸引力的教學方法（如故事教學與故事板教學）不僅能提升師生間的大腦同步程度，還能顯著增強學習成效。對家長與照顧者而言，理解不同反饋方式對大腦活動的影響，有助調整溝通方式，從而促進兒童的情感與認知發展。我們的探索也為未來的研究指引方向，進一步揭示大腦活動、社交互動與兒童發展之間的複雜關聯。

In recent years, the focus of research on child development and early education has shifted from simply measuring academic and developmental outcomes to exploring the processes behind them. At the heart of both learning and development is social interaction, a central concept in many psychological theories, such as Vygotsky's sociocultural theory and Bronfenbrenner's ecological systems theory. By analysing the psychological mechanisms involved in these interaction processes, we can gain a deeper understanding of their role in children's learning and development, and study how the brain processes learning and social interaction. These studies not only provide empirical evidence to support these psychological theories but also help identify the neural pathways involved, enabling us to develop more targeted educational strategies and interventions that enhance child development.

Brain Synchronisation and Educational Outcomes

In recent years, scientists have used advanced neuroimaging techniques, such as functional near-infrared spectroscopy (fNIRS) hyperscanning, to explore the influence of brain synchronisation (also known as inter-brain synchrony) on both educational experiences and family dynamics. Brain synchrony refers to the state in which two or more individuals (such as a student and a teacher) exhibit significant synchrony in brain activation patterns in specific regions of the brain during social interactions, a phenomenon called 'inter-brain neural coupling'.



47對母女在完成拼圖任務時的大腦同步採集場景

The experimental setting during the brain-to-brain coupling collection of 47 mother-daughter pairs in a jigsaw puzzle task

Our research group has used fNIRS hyperscanning to observe, in real time, the brain activity of children and adults during learning and family interactions. The aim is to investigate the role of brain synchronisation in children's interactions with their social environment. Our research findings not only reveal how enhancing educational and parenting practices can improve developmental outcomes at the neural level, but also highlight the importance of interpersonal brain synchronisation as a reliable indicator for assessing the quality of children's interactions with their social environment.

Story-Based Teaching: Enhancing STEM Learning at the Neural Level

STEM (science, technology, engineering, and mathematics) education is crucial for children's future academic development, but identifying the most effective teaching methods for these critical subjects remains a challenge. Our research group investigated how three different teaching approaches—traditional lecturing and more engaging, creative methods (storytelling using picture books and storyboards)—in STEM educational settings affect brain synchronisation between students and teachers in STEM learning environments.

The results of our study show that in the storytelling condition, brain synchronisation between the left and right inferior frontal gyrus (IFG)—regions involved in language and information processing—was significantly higher than in the traditional lecture condition. Storytelling, with its narrative structure and emotional engagement, appeared to promote greater brain synchronisation between the teacher and the student. Similarly, when storyboards were used, increased synchronisation was observed in the superior temporal gyrus (STG), a region associated with the processing of auditory and visual information. This suggests that visual storytelling tools such as storyboards may enhance the brain's ability to integrate and retain STEM concepts.

In addition, our study revealed a strong relationship between brain synchronisation and learning outcomes. In the storytelling condition, synchronisation in the left supramarginal gyrus (SMG)—a region crucial for processing sensory information and integrating it into understanding—was positively correlated with improved STEM learning outcomes. Therefore, the degree of brain synchronisation between students and teachers not only directly affects the effectiveness of information absorption, but also serves as a key indicator of learning outcomes. This finding reveals a key mechanism in the learning process and opens up new avenues for improving teaching practices in the classroom.

How Family Dynamics Influence Child Development

In another study, we observed the performance of 47 mother-daughter pairs in a jigsaw puzzle task to investigate how positive and negative parental feedback affects brain synchronisation between mothers and daughters, and to better understand children's neural responses when interacting with their parents.

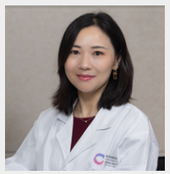
The study showed that negative feedback significantly reduced brain synchronisation between mothers and daughters in areas such as the left dorsolateral prefrontal cortex (dlPFC) and right inferior frontal gyrus (IFG), which are crucial for regulating emotions and processing social interactions. In other words, negative feedback may disrupt the neural pathways that help children process and cope with emotional experiences. In contrast, positive feedback was associated with increased synchronisation in these regions, suggesting that encouraging feedback helps mothers and daughters understand each other better during interactions.

We also found that families with a 'conformity communication pattern'—defined by rigid, authoritarian communication—showed less synchronisation in brain areas related to emotional regulation and language processing. In contrast, families with a more open and conversational communication style exhibited greater synchronisation, suggesting that warmth and flexibility in communication support better emotional and cognitive development in children.

Notably, emotionally resilient children maintained strong brain synchronisation with their mothers, even when they received negative feedback. This suggests that resilience may buffer against the negative neural effects of criticism, helping children cope with challenges more effectively, both in terms of information processing and emotional regulation.

Bridging Science and Practice

Using advanced fNIRS hyperscanning technology, our studies have demonstrated the strong connection between brain synchronisation and both academic learning and emotional development, both in the classroom and at home. For educators, adopting more creative and engaging teaching methods such as storytelling and storyboarding can enhance brain synchronisation and improve learning outcomes. For parents and caregivers, understanding how different types of feedback affect brain synchronisation can help develop nurturing and effective strategies to support children's emotional and cognitive growth. Overall, our studies pave the way for future research to explore the complex relationships between brain activity, social engagement, and developmental outcomes.



張娟是澳門大學教育學院副教授，澳門大學教育學院幼兒教育及兒童發展中心主任，同時為澳門大學認知與腦科學研究中心成員。

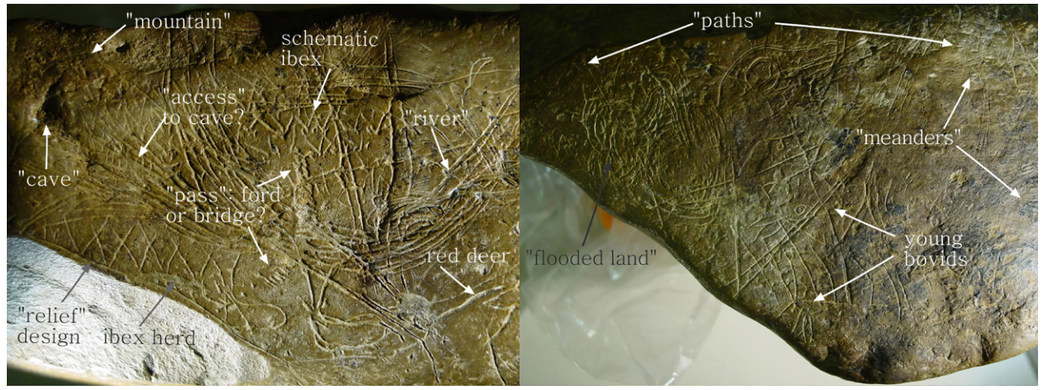
Zhang Juan is an associate professor in the Faculty of Education, director of the Centre for Early Childhood Education and Child Development, and a member of the Centre for Cognitive and Brain Sciences at the University of Macau.

王一暉是澳門大學教育學院博士生，導師為張娟副教授。

Kira Wang Yihui is a PhD student in the Faculty of Education at the University of Macau, under the supervision of Prof Zhang Juan.

「學術研究」為投稿欄目，內容僅代表作者個人意見。

Academic Research is a contribution column. The views expressed are solely those of the author(s).



人類已知的最早圖解之一——西班牙阿邦茨洞穴的石板

One of the earliest known diagrams made by humans is on a stone tablet discovered in Abauntz Cave in Spain

從洞穴到電腦：圖解的演變

From Cave to Computer: The Evolution of Diagrams

文：Michael Whittle｜圖：Michael Whittle、Pilar Utrilla｜中文翻譯：郭麗雅

Text: Michael Whittle｜Photo: Michael Whittle, Pilar Utrilla｜Chinese Translation: Gloria Kuok

在資訊泛濫、全球挑戰複雜的時代，圖解（Diagrams）成為引導人類理解世界的重要工具——然而，它絕非新鮮事。其出現時間比書面語言還要早五倍，從石器時代的洞穴標記一路演變到今天的互動式可視化，這長達一萬五千年歷史的圖解思維譜系，為科學與藝術領域帶來新思考。

主動促進理解和創新的工具

圖解是連接抽象思維與視覺呈現的重要橋樑。人類已知的最早圖解之一，是在西班牙阿邦茨洞穴中發現的一塊約公元前13,600年的石板上。它不但描繪了山谷的地貌、水路和野生動物等地理特徵，更通過對路徑、狩獵場和獸群遷徙的具象化，暗示了時間和戰略元素。

這件文物揭示了圖解的基本事實：其不只是被動記錄，更是幫助主動理解和創新的工具。從洞穴壁畫到數字化形式，圖解正成為跨界於科學與藝術實踐之間的獨特創作模式。

圖解的科學性與藝術性

觀察發現，圖解在科學實驗室和當代藝術實踐中驚人地相似，這有助我們深入研究圖解式思維如何在兩個領域中生成知識，進而構建分析圖解的框架。我們從中總結出四種同中有異的圖解製作方法：

1)生成性圖解：用於創新性實驗的動態工具。科學家利用可視化方式進行腦力激盪，構建新假設與解決方案，而尼古拉斯·根斯特勒和朱莉·梅赫雷圖等藝術家，則用它開拓視覺和概念上的新可能。於是，繪製標記的過程成為一種思考形式，將原有想法不斷重構，從而產生新見解。

2)簡化性圖解：科學家和藝術家常創作出如羅蘭·巴特所說「質樸且神聖簡約美學」的圖像，即簡化至最核心的元素。科學家通過簡化或降低複雜性來控制特定變量或關係，而伊夫·內茨哈默等藝術家則將簡化推向極致，塑造出視覺鮮明，蘊含複雜心理意象的作品。

3)符號性圖解：網格、刻度、坐標軸等科學符號常出現在科學和藝術領域。科學家將其用於科學測量，而安玟烜等藝術家則重新詮釋，以生動且幽默的方式，通過客觀的科學方法重構主觀的童年記憶。

4)具身性圖解：科學家和藝術家均意識到肢體和動作在理解複雜概念中的重要性。科學家經常用手勢解釋分子相互作用或數學概念，而瑪麗艾拉·格雷爾等藝術家則將身體視為探索和交流的圖解工具。

科學的詩學：基於實踐的研究

上述這四種圖解製作方法常在當代藝術實踐中相互交融，這一點，正好在我於香港策劃的一場名為「好奇心櫃：21世紀奇物館（A Cabinet of Curiosities: A Wunderkammer for the 21st Century）」的展覽中得到充分展示。其匯聚了40位國際藝術家和科學家的作品，探索圖解是如何形成人們對複雜現象的理解，有的作品更展示了不同圖解的合力作用。

本人的藝術裝置*Perpetual Motion*展出於其中，它包含一塊特別設計的地氈，通過符號性圖解和具身性圖解，把諾貝爾獎得主邁-布里特·莫澤和愛德華·莫澤關於大腦網格細胞的研究化為複雜的幾何圖案，參觀者可在這件裝置上穿行，以身體感受複雜的科學概念。另外還安排了現代舞者在地氈上演出，舞者形神相契，帶出作品將科學理解與身體體驗動態結合的深層含義。

另外，鄧伯軒的藝術裝置《慣性》同樣在藝術詮釋與科學精確性之間巧妙平衡。他移除了鐘面上的時針和分針，並以指南針取代秒針，將關於磁場空間和時間周期的迷人效果視覺化。這裝置在混沌與同步之間交替變換，既準確展示物理原理，也飽含對時間和聯繫的詩意思索。

連接過去與未來：成果與啟示

四種圖解方法及其在展覽中的應用反映一個事實：科學圖解與藝術圖解之間的界限遠沒有傳統認知中那麼涇渭分明。該發現為視覺思維的未來發展帶來重要啟示。

數字技術革新了製作圖解的方式，還擴展了圖解的表意範圍，如互動式可視化助力探索多維資訊，而擴增實境能將圖解資訊疊加到現實世界中。面對從氣候變化到人工智能治理等日益複雜的全球挑戰，整合這些方式至關重要。現代圖解製作者不僅在科學精確性與藝術洞察力之間搭建橋樑，還須連通人類認知與機器學習、地方行動與全球發展，以及過去經驗智慧與未來創新願景。

如此一來，圖解延續自洞穴壁畫起始的征程，引導我們以嶄新視角觀察、理解世界，激發對未來世界的想像與塑造。

In an age of information overload and complex global challenges, diagrams have emerged as essential navigational tools for human understanding—yet their power is anything but new. In fact, these visual thinking frameworks are five times older than written language, evolving from Stone Age cave markings to today's interactive data visualisations. This enduring 15,000-year lineage of diagrammatic thinking offers crucial solutions and innovative insights across the realms of science and arts.

Active Tools for Understanding and Innovation

Diagrams bridge the gap between abstract thought and visual representation. One of the earliest known diagrams made by humans is on a stone tablet discovered in Abauntz Cave in Spain, dating to around 13,600 BCE. The stone tablet features a sophisticated topographical diagram depicting the local terrain, waterways, and wildlife of the valley. It goes beyond the mere recording of physical

藝術裝置《慣性》在藝術詮釋與科學精確性之間巧妙平衡

The art installation *Inertia* balances scientific precision with artistic interpretation

舞者在藝術裝置*Perpetual Motion*上演出，帶出作品將科學理解與身體體驗動態結合的深層含義。

A dancer performs on the art installation *Perpetual Motion*, adding a deeper layer of meaning to a dynamic fusion of scientific understanding and bodily experience.

features by suggesting temporal and strategic elements through the tactile representation of paths, hunting grounds, and herd movements.

This relic reveals a fundamental truth about diagrams: they serve not just as passive recordings but as active tools for understanding and innovation. As diagrams have evolved from cave walls to digital interfaces, they have developed into distinct patterns of creation that cross the boundaries between scientific and artistic practice.

Scientific and Artistic Dimensions of Diagramming

By observing the striking similarities between the diagrams found in scientific laboratories and those created in contemporary art practice, we can understand how diagrammatic thinking shapes knowledge production in both fields, and thus develop a framework for analysing these visual tools. By examining how artists and scientists create and utilise diagrams, we have identified four distinct but overlapping approaches to diagram-making:

1) Generative diagrams: These serve as dynamic tools for creative experimentation and discovery. Scientists visually brainstorm ideas to explore hypotheses and model possible solutions, just as artists such as Nikolaus Gansterer and Julie Mehretu use them to generate new visual and conceptual possibilities. In both cases, the act of mark-making becomes a form of thinking, as ideas are dynamically reconfigured to generate new insights.

2) Reductive diagrams: Both scientists and artists often create images that reflect what Roland Barthes called 'an aesthetics of bareness and sacred simplicity', indicating that the images are stripped to their essential elements. While scientists add simplicity or reduce complexity to isolate specific variables or relationships, artists such as Yves Netzhammer push this reduction further, creating a stark visual poetry that embodies complex psychological metaphors.

3) Notational diagrams: The systematic elements of scientific notation, such as grids, scales, and axes, appear in both domains. Scientists use them for scientific measurement, while artists like Minjeong An repurpose these conventions to movingly and often comically reframe subjective childhood memories through a lens of objective scientific analysis.

4) Embodied diagrams: Both scientists and artists recognise the role of physical gesture and movement in understanding complex ideas. Scientists often use hand movements to explain molecular interactions or mathematical concepts, while artists such as Mariella Greil make this embodied understanding explicit, treating the body itself as a diagrammatic tool for exploration and communication.

A Poetics of Science: Practice-Based Research

The abovementioned four approaches to diagram-making converge in contemporary artistic practice, and were demonstrated in an exhibition I curated, 'A Cabinet of Curiosities: A Wunderkammer for the 21st Century' held in Hong Kong. The exhibition brought together 40 international artists and scientists, many of whom explore how diagrams shape our understanding of complex phenomena. Several works also demonstrated how diagrammatic approaches can work in combination.

My art installation *Perpetual Motion* was on display at the Hong Kong exhibition. It includes a specially designed carpet that merges notational and embodied diagrams by transforming Nobel laureates May-Britt Moser and Edvard Moser's research on grid cells into an intricate geometric pattern. Visitors could physically traverse the installation and experience complex scientific concepts through their bodies. We also arranged for a contemporary dance performance to be staged on this carpet, adding a deeper layer of meaning as the dancers' movements across the space echoed the neural activity occurring within their own minds, weaving together a dynamic fusion of scientific understanding and bodily experience.

On the other hand, Shawn Pakhin Tang's art installation *Inertia* similarly balances scientific precision with artistic interpretation. He removed the hour and minute hands from a clock and replaced the second hands with compass needles, creating a mesmerising visualisation of magnetic fields and temporal cycles. Alternating between chaos and synchronisation, the installation offers both an accurate representation of physical principles and a poetic meditation on time and connection.

Bridging Past and Future: Outcomes and Implications

The examination of the four diagrammatic approaches and their applications in the exhibition setting reveals a fundamental truth: the boundaries between scientific and artistic diagramming are far more permeable than traditionally acknowledged. This finding has important implications for the future of visual thinking.

Digital technologies have not only transformed the way we create diagrams, but also expanded what they can represent. Interactive visualisations allow us to explore multidimensional datasets, while augmented reality enables us to overlay diagrammatic information onto the physical world. As we face increasingly complex global challenges, from climate change to artificial intelligence governance, the integration of these approaches becomes critical. Modern diagram-makers must bridge not only scientific precision and artistic insight, but also human cognition and machine learning, local action and global systems, past wisdom and future possibilities.

In this way, diagrams continue the journey that began on cave walls—helping us not only to see and understand our world in new ways, but also to imagine and shape its future.

Michael Whittle 是澳門大學人文學院藝術與設計系當代藝術副教授。他的跨學科研究主要探究科學與藝術在視覺化實踐中的交匯。他起初學習生物化學，後轉為學習美術，這一雙重學術背景影響了他對視覺思維工具的研究。他在英國倫敦皇家藝術學院取得雕塑碩士學位，並以日本文部省研究學者身份在京都藝術大學獲得雕塑博士學位，其博士論文聚焦於當代藝術實踐中的圖解思維。

Michael Whittle is an associate professor of contemporary art in the Department of Arts and Design, Faculty of Arts and Humanities, University of Macau. His interdisciplinary research explores the intersection of scientific and artistic visualisation practices. Prof Whittle was originally trained as a biochemist before transitioning to fine art. This dual background informs his approach to visual thinking tools. Prof Whittle holds an MA in Sculpture from the Royal College of Art in London, and a PhD in Sculpture as a Japanese Monbusho Research Scholar at Kyoto City University of Arts, where his dissertation focused on diagrammatic thinking in contemporary art practice.

院長羅茜教授、創院院長姚偉彬教授與超過250名師生和校友參加何鴻燊東亞書院院慶啟動儀式暨「校友之夜」

College Master Prof Luo Qian, Founding Master Prof Iu Vai Pan and over 250 students, faculty, and alumni attend the kick-off ceremony of SHEAC's anniversary celebrations and 'Alumni Night'.

東亞新章：書院為家
學術與實踐並行的前進之路

SHEAC: A Warm Home for Students to Grow Academically and Personally

文、圖：羅茜、陳宇威

Text & Photo: Luo Qian, Chan U Wai

2月之夜，華燈初上，澳門大學何鴻燊東亞書院（下稱書院）慶祝書院15周年院慶活動正式拉開帷幕，在首場大型慶典活動——「校友之夜」晚宴上，書院邀請了逾250名師生和校友參與，透過大螢幕上的相片和視頻，將大家的記憶拉回到書院初立的2010年。由創院院長姚偉彬教授帶領著團隊，推動書院穩健發展，師生有序開展各類教育項目，一步步築牢了書院的人文教育根基。如今，持續優化書院建設、為院生打造更優質的成長環境，已成為我們肩負的核心使命。

過去十五年的篇章：書院的人文基石

這晚的「回家」活動，不僅讓校友重溫校園記憶，更為院生創造了與前輩深度交流的機會。大家一邊享受著美食，一邊熱烈交流著過去在書院的點滴，並共同致謝創院院長姚偉彬教授，感謝其在過去14年作出的巨大貢獻。

過去在姚院長的帶領下，書院始終秉持「全人發展」的教育理念，鼓勵院生根據志趣參與不同的教育項目，發揮所長。例如，運動愛好者可參加競技啦啦隊、足球隊和籃球隊等院隊，提升運動能力，並為書院爭取榮譽。今年，書院蟬聯澳門大學院長盃總冠軍，印證了院生努力訓練的成果。對於熱愛讀書和知識分享的同學，歡迎加入讀書會，深入探討書本知識，或參與「東亞正義課」，與志同道合的院生共同思辨真理與價值觀。

東亞新章：溫暖的家，引導學生知行合一

去年8月起，隨著新院長羅茜教授的上任，我們在姚院長的豐碩成果基礎上，努力優化書院的各項工作，強化「第二個家」的理念，讓書院成為實踐知識的平台，引導學生知行合一。

為了讓院生更愛這個「家」，書院團隊從基礎做起，優化書院的生活環境。本學年，我們首次舉辦「環境衛生模範生挑戰賽」，活動廣受學生歡迎，吸引了超過150名院生參加，顯著改善了書院的衛生和環境。為了提高「家」的凝聚力，我們舉辦了「生日禮『遇』」，為院生贈送生日餐券，超過250名師生參加活動，在書院享受共膳時光，成功營造更溫馨的氛圍。

我們希望通過強調「家」的理念，使書院成為院生們一個強大而溫暖的港灣，讓他們在良好的環境和社交氛圍中，專心於學術和勝任力的發展，勇敢地向理想揚帆。這一過程並不容易，因此書院從三方面系統性地引領同學確立志向，朝目標前進。

東亞共學：學術互助，攜手前行

首先，本學年書院更著重學術能力的提升，推出了「東亞共學」計劃，鼓勵成績優異的學生共同學習，並輔導有需要的同學。正如《禮記・學記》所言：「學然後知不足，教然後知困。」教學相長雖是老生常談，但唯有通過這個過程，才能發現自己對某些知識的困惑，從而牢固掌握知識，將其存放於一生中都能應用的知識庫裡。

其次，學習知識後，更重要的是如何與實踐緊密結合，因此，書院重視實踐教育。以環保教育為例，我們在3月至4月期間，舉辦了「世界地球日」系列活動，包括社區剩食及紙皮回收體驗（這同時能讓學生了解本地基層家庭的生活情況）、淨灘行動等，並提高了書院回收站的效率。透過這些活動，院生們不僅理解了「減廢減碳」是國家重大環保政策，對全球可持續發展十分重要，還能親身體驗有效的環保措施，以及社區組織如何推動相關的公益活動，將個人的影響力擴展至社區之中。

最後，書院全面強化生涯規劃工作，包括舉辦多場生涯規劃諮詢午餐及茶聚，並帶領同學前往大灣區和北京，參觀國內最頂尖的高校、企業和創科中心。通過這些實地交流，學生能更直觀地了解國家和內地市場的最新發展動態，從而準確把握自己在國家發展藍圖中的角色和定位，及早為未來做好準備。

十五載新程：助院生逐夢遠航

15周年標誌著書院新篇章的開始，書院將繼續致力成為院生溫暖的家，透過更完善的生涯規劃項目，協助他們確立人生志向；透過多樣的教育項目，提升學生的學術能力和勝任力，並讓書院成為實踐的窗口，讓院生從經驗中理解知識的應用，更好地裝備自己，迎接光明未來。

院長羅茜教授與師生、校友舉杯賀院慶

College Master Prof Luo Qian toasts with students, faculty, and alumni to celebrate the anniversary.

書院舉辦「生涯規劃諮詢午餐」，院生與教授交流升學及就業的最新消息和見解。

Students and professors share the latest news and insights on further education and employment during further studies consultation lunch meetups hosted by SHEAC

書院積極推動各項環保和教育工作，鼓勵同學參與「剩菜回收項目」，實地體驗和支持社區環保項目。

SHEAC actively supports environmental and educational initiatives such as the food waste recycling scheme, where students get involved in and support environmental projects in the community.

On a February evening, Stanley Ho East Asia College (SHEAC) of the University of Macau (UM) kicked off its 15th anniversary celebrations. The first major event was 'Alumni Night', a gala dinner that brought together 250 students, faculty, and alumni. As photos and videos flashed across screens in the venue, SHEAC members were transported back to 2010, the year in which the college was established. Under the leadership of Founding Master Prof Iu Vai Pan, the college has grown steadily through a variety of educational initiatives and the efforts of students and faculty, laying a solid foundation for liberal arts education. Today, its core mission remains clear: to consistently enhance the college's offerings and provide an even more enriching environment in which students may grow and thrive.

Laying a Foundation for Liberal Arts Education

The gala dinner was more than just a celebration—it was a 'homecoming' event for SHEAC alumni, allowing them to reminisce about their cherished UM memories. For current students, it was an opportunity to connect with alumni. Throughout the evening, everyone shared stories about the college while enjoying delicious food, and expressed their gratitude to Founding Master Prof Iu Vai Pan for his immense contributions to the college over the past 14 years.

Under Prof Iu's leadership, SHEAC has remained committed to promoting whole-person development by offering diverse educational initiatives that allow students to explore their passions. Sports enthusiasts can hone their athletic skills and represent the college in competitions by joining college cheerleading, football, or basketball teams. This year, SHEAC won the CICA (Committee on Inter-College Affairs) Master's Cup Overall Championship organised by the university again, a testament to the hard work and dedication of the students. Meanwhile, those with a love of reading and intellectual exchange can join the reading groups for in-depth discussions, or take part in the 'Justice Workshop Series' to debate ideas with peers.

Guiding Students to Achieve the Unity of Knowledge and Action

In August of last year, Prof Luo Qian assumed her role as SHEAC's new college master. Building on Prof Iu's legacy, the management team has continued to improve various aspects of the college, while further developing the college into the students' 'second home'. The team aims to transform the college into a platform where students can put their knowledge into practice and achieve the unity of knowledge and action.

To cultivate students' attachment to the college, the management team started with the fundamentals—enhancing the living environment. This academic year marked the debut of the 'Clean Room Challenge', which attracted over 150 students and greatly improved the hygiene and environmental conditions of the college. To strengthen the sense of community among SHEAC members, the college organised the 'Birthday Meal Gathering' and distributed birthday meal vouchers to students. More than 250 students and faculty attended the gathering and enjoyed meals together in a warm and collegial atmosphere.

By highlighting the concept of 'home', SHEAC aims to make itself both a welcoming haven and a springboard for growth—a place where students can focus on academic growth and competency development in a supportive and vibrant community, while gaining the confidence to pursue their ambitions. Recognising that the transition from university life to the 'real world' is not easy, the college has launched three initiatives to guide students to define their aspirations and accomplish their goals.

Progressing Together Through Different Initiatives

This academic year, SHEAC has placed greater emphasis on fostering academic excellence among students through the launch of the SHEAC Tutorial Programme. This initiative encourages high-achieving students to study with peers and mentor those who need support. As the 'Record on the Subject of Education' chapter of the *Book of Rites* states: 'Through learning, one discovers their limitations; through teaching, one understands the true challenges of learning.' We believe that 'to teach is to learn twice'—through mentoring others, students not only identify gaps in their knowledge but also deepen their mastery of learning, thus turning information into lasting wisdom that will serve them beyond graduation.

Apart from acquiring knowledge, integrating knowledge with practice is of paramount importance. SHEAC prioritises experiential learning. Take environmental education for example: in March and April this year, the college organised a series of Earth Day activities, including food waste and cardboard recycling (which gave students insight into the lives of local families at the grassroots level), beach cleanups, and upgrading the college's recycling station. Through these activities, students not only understood how reducing waste and carbon emissions align with the country's environmental policies and global sustainable development goals, but also experienced first-hand how effective eco-friendly initiatives—and the community organisations driving them—can amplify individual impact into collective change.

In addition, the college has strengthened its career planning support. This includes hosting several lunch meetups and tea sessions to provide further studies consultation, and taking students on study tours to the Guangdong-Hong Kong-Macao Greater Bay Area and Beijing to visit leading universities, enterprises, and innovation centres. These visits and exchange activities have provided students with direct exposure to the latest developments in mainland China and its market, enabling them to define their roles in national development and confidently prepare for the future.

Empowering Students to Sail Towards Their Dreams

SHEAC's 15th anniversary marks the beginning of a new chapter of its development. The college will remain committed to creating a warm home for students and providing more comprehensive career guidance so that they can chart their career paths. Through various educational initiatives, the college will continue to sharpen students' academic skills and core competencies, while transforming itself into a platform for practical learning. We hope to empower students to translate knowledge into tangible skills through diverse experiences, preparing them for a promising future.

羅茜是澳門大學何鴻燊東亞書院院長及生物醫學系教授。就任院長之前，曾擔任澳門大學健康科學學院生物醫學系系主任。羅教授畢業於北京大學（本科和碩士）及英屬哥倫比亞大學（生物學博士），並曾在多所世界頂尖大學任教，包括新加坡南洋理工大學和香港科技大學。

Luo Qian is the college master of Stanley Ho East Asia College (SHEAC) and a full professor in the Department of Biomedical Sciences of the Faculty of Health Sciences at the University of Macau (UM). Before joining SHEAC, she held the position of head of the Department of Biomedical Sciences at UM. A graduate of Peking University (BSc and MSc) and the University of British Columbia (PhD), Prof Luo has taught at several top universities worldwide, including Nanyang Technological University in Singapore and the Hong Kong University of Science and Technology.

陳宇威是獲得澳門大學社會學哲學博士學位，現任何鴻燊東亞書院導師。陳博士為土生土長的澳門人，曾在特區政府及國際扶貧組織工作，擁有超過15年的教學及社區服務經驗。

Chan U Wai is a resident fellow of Stanley Ho East Asia College and holds a PhD in Sociology from the University of Macau. Born and raised in Macao, Dr Chan has over 15 years' experience in teaching and community service. He has previously worked for the Macao SAR Government and international poverty alleviation organisations.

「書院發展」為投稿欄目，內容僅代表作者個人意見。

RC Development is a contribution column. The views expressed are solely those of the author(s).

澳大於2010年引入住宿式書院系統。書院作為多元文化與多元學科融會貫通的知識整合學習平台，致力培養學生具有公民責任心、全球競爭力、知識整合能力、團隊協作、服務與領導、文化參與和健康生活的七項勝任力。

UM launched its residential college (RC) system in 2010 to create a multicultural and multidisciplinary learning platform for knowledge integration. RC education aims to cultivate seven competencies of students, namely responsible citizenship, global competitiveness, knowledge integration, teamwork and collaboration, service and leadership, cultural engagement, and healthy lifestyle.

住宿式書院系統網站

Website of the Residential College System

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