Faculty of Education
CUHK 中大教育

第三屆
粵港澳促進STEAM教育大會
AI時代下的STEAM教育
論文集（摘要）

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Centre for Learning Sciences and Technologies
The Chinese University of Hong Kong

香港電腦教育學會
The Hong Kong Association for Computer Education

華南師範大學
SOUTH CHINA NORMAL UNIVERSITY

CAET 中国教育技术协会
CHINA ASSOCIATION FOR EDUCATIONAL TECHNOLOGY

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大會主席

李克東教授

粵港澳促進 STEM 教育聯盟理事長
華南師範大學教育技術研究所所長
華南師範大學教育信息技術學院教授

热烈欢迎各位老师莅临香港中文大学，参加第三届粤港澳促进 STEM 教育大会！

本次大会由粤港澳促进 STEM 教育联盟主办，香港中文大学教育学院承办。

粤港澳促进 STEM 教育联盟成立于 2016 年 9 月，旨在落实教育部提出的要求：“积极探索信息技术在‘众创空间’、跨学科学习（STEAM 教育）、创客教育等新型教育模式中的应用，着力提升学生信息素养、创新意识与能力，培养数字化学习习惯，促进学生全面发展，发挥信息化面向未来培养高素质人才的支撑引领作用。”联盟由华南师范大学教育信息技术学院与香港智库创新教育学会联合发起，邀请广东、香港、澳门等地区的学校、教育团体共同协商，作为创始成员成立“粤港澳促进 STEM 教育联盟”，致力于推动粤港澳地区 STEM 教育在中小学的实践应用。

自成立以来，联盟在粤、港、澳三地建立了 30 余所实验学校，并陆续举行挂牌仪式；为广东、香港、澳门及厦门等地的中小学教师举办了 20 余场 STEM 专题培训班，或深入实验学校课堂开展教学研讨，助力一线教师专业发展。同时，联盟积极推动校际交流，组织学校参访澳门培正中学、东莞松山湖实验中学等优秀案例，促进合作与经验分享。

2018 年 11 月，联盟以粤港澳大湾区 STEM 教育特色成果身份，亮相在珠海举办的第四届中国教育创新成果公益博览会，获得广泛关注。联盟组织 14 所实验学校展示 18 项 STEM 教学成果，并主办 16 场工作坊，受到一线教师的热烈欢迎。

联盟还致力于本土化教材研发，已出版《粤港澳大湾区 STEM 教育联盟实验学校案例集》，发表《STEM 教育跨学科学习活动 5EX 设计模型》等研究成果，推动适合粤港澳大湾区实际的 STEM 课程建设。同时，联盟持续组织大型研讨与交流活动，搭建教师专业成长平台。

第一届粤港澳促进 STEM 教育大会于 2019 年 4 月在华南师范大学成功举办，吸引来自香港、澳门、广东、福建、河南、内蒙古等地 70 多所学校的 400 多名师生参加。大会设有 15 场主题报告、9 个分会场及丰富多样的教学工作坊，台湾师范大学洪荣昭教授、陕西师范大学胡卫平教授等知名专家作主题演讲，参会教师围绕 STEM 项目实施、学生创新能力培养与教师专业发展等主题，展开深入交流。

第二届粤港澳促进 STEM 教育大会原计划于 2020 年在澳门举办，因疫情未能成行。经联盟理事会决定，于 2023 年底在华南师范大学与第二届粤港澳跨学科教育论坛合并举办。

第三届粤港澳促进 STEM 教育大会定于 2025 年 7 月 4 日在香港中文大学教育学院举行。大会内容丰富、形式多样，除主题报告外，还将举办学生学习成果展、老师和学生共同参与的 STEM 工作坊、中小学校长论坛、论文分享、教学案例展示等多个专题活动。诚邀粤港澳三地的教育同仁踊跃参与，共同推动粤港澳大湾区 STEM 教育高质量发展！

二、序言

程序委員會暨組織委員會共同主席

莊紹勇教授（香港中文大學）

感謝李克東教授委以重任，讓香港中文大學學習科學與科技中心、香港電腦學會、華南師範大學、中國教育技術協會共同籌辦本屆的粵港澳促進 STEAM 教育大會。

第三屆粵港澳促進 STEAM 教育大會於 2025 年 7 月 4 日至 5 日，在香港中文大學召開。在人工智能浪潮席捲全球的今日，教育的變革與創新不容忽視，本屆大會主題為「AI 時代下的 STEAM 教育」，匯聚各方力量，探討未來教育的各種可能。

自籌備以來，大會幸得粵港澳三地學術界及教育界熱烈迴響與鼎力支持。本屆大會共收到來自內地、香港、澳門三地的論文摘要與教學案例等各類稿件逾 177 篇（見表一及二），投稿不僅數量可觀，更在地域分佈上體現了廣泛的參與性。稿件內容全面涵蓋了本屆大會的七個子主題，包括：「人工智能教育」、「STEAM 教育與創客教育」、「科技推動下的個性化與自主學習」、「科技促進科學教育的學與教」、「科技創新下的跨學科教師專業發展」、「跨學科教育技術創新、政策與改革」及「技術支持下的跨學科學習分析與評估」。其創見更令人鼓舞，每一份來稿，都是對教育的大膽創新與務實執行的成果，充分彰顯了我們 「跨專業、跨區域、跨語言」的辦會宗旨。

子會議主題	中國內地	中國香港	中國澳門	**各主題總計**
1. 人工智能教育	25	6	0	**32**
2. STEAM 教育與創客教育	13	11	1	**25**
3. 科技推動下的個性化與自主學習	13	7	3	**23**
4. 科技促進科學教育的學與教	3	0	0	**3**
5. 科技創新下的跨學科教師專業發展	7	0	0	**8**
6. 跨學科教育技術創新、政策與改革	3	1	0	**4**
7. 技術支持下的跨學科學習分析與評估	4	2	0	**6**
各區域總計	**68**	**27**	**4**	**101**

表一：論文摘要投稿統計

子會議主題	中國內地	中國香港	中國澳門	**各主題總計**
1. 人工智能教育	16	6	0	**22**
2. STEAM 教育與創客教育	17	13	2	**32**
3. 科技推動下的個性化與自主學習	0	10	0	**10**
4. 科技促進科學教育的學與教	4	1	0	**5**
5. 科技創新下的跨學科教師專業發展	0	1	0	**1**
6. 跨學科教育技術創新、政策與改革	3	2	0	**5**
7. 技術支持下的跨學科學習分析與評估	0	1	0	**1**
各區域總計	**40**	**34**	**2**	**76**

表二：教學案例投稿統計

本次盛會，我們榮幸地邀請到四位來自粵港澳三地的頂尖學者擔任主旨報告嘉賓。香港中文大學的蔡敬新教授將探討如何「以多智能體工作流支援中學生建構專題作業」；華南師範大學的柯清超教授則聚焦於「中小學人工智能通識教育：從技術崇拜到思維培養」，同校的鍾柏昌教授將分享「新一代人工智能課程體系與教材開發」的寶貴經驗；而澳門大學的范進偉教授會帶來關於「澳門人工智能課程發展與法規」的實踐與成效分析。四位專家的真知灼見，將為大會提供高瞻遠矚的學術引領。

尤其值得一提的是，本屆大會特設「中小學校長論壇」，匯聚了 18 位來自粵港澳大灣區的中小學校長。他們將立足於教育管理與實踐的最前線，分享各自對推行 STEAM 教育及迎接 AI 時代挑戰的真知灼見，為理論與實踐的結合提供寶貴的領導者視角。也有專題探討「香港小學科學科新課程－如何有效規劃及推展」，分享小學科學科專業學習社群教學先導計劃成果。

此外，為促進深入交流與實踐分享，大會安排三場專題工作坊。澳門培道中學將主持題為《跨學科學習活動設計、實踐與評價》的工作坊、濠江中學則會分享其《AI 水培助手》計劃及華南師範大學則帶來《CALE 課程設計：從批判性思維到批判性行動》的工作坊。提供更多實踐層面的互動與探討。結合一線教師的實踐分享、學術論文發表及充滿活力的學生作品展示，匯聚一堂，切磋交流，激盪思想。我們深信大會將為推動粵港澳大灣區的 STEAM 教育合作走深走實，提供豐沛的養分與不竭的動力。

最後，謹向為本屆大會順利召開付出辛勤努力的組織委員會、程序委員會的各位委員及全體工作人員，致以最衷心的感謝。我們尤其要感謝大會主席對會議統籌工作的悉心指導與鼎力支持。盼望參加者能在大會各項活動中，充分交流，獲得豐碩成果。

程序委員會共同主席
尚俊杰教授（北京大學）

在科技浪潮奔涌的 AI 時代，我們懷揣著對教育創新的熱忱，相聚于香港中文大學，共同開啓第三届粵港澳促進 STEAM 教育大會的帷幕。在此，我們謹代表主辦單位——香港中文大學學習科學與科技中心、香港電腦教育學會、華南師範大學、中國教育技術協會，向莅臨現場的各位嘉賓表示最熱烈的歡迎！向長期以來關心支持粵港澳 STEAM 教育發展的各界朋友致以最誠摯的感謝！

“科技興則民族興，科技强則國家强。”當人工智能、大數據、物聯網等新技術以前所未有的速度重塑社會形態，教育作爲國之大計、黨之大計，肩負著培養未來創新人才的歷史使命。STEAM 教育以科學（Science）、技術（Technology）、工程（Engineering）、藝術（Arts）、數學（Mathematics）的跨學科融合爲核心，正是應對 AI 時代挑戰的關鍵路徑。它不僅是知識的傳授，更是創新思維、問題解决能力和跨界協作素養的培育，是培養“能適應未來、創造未來”的時代新人的重要基石。

粵港澳大灣區作爲中國開放程度最高、經濟活力最强的區域之一，在國家發展大局中具有重要戰略地位。推動大灣區 STEAM 教育協同發展，既是落實國家戰略的必然要求，也是三地教育界把握時代機遇、共育創新人才的主動擔當。本届大會以“AI 時代下的 STEAM 教育”爲主題，正是希望通過跨專業、跨區域、跨語言的深度交流，匯聚三地智慧，探索科技與教育融合的新範式，爲大灣區乃至全國的 STEAM 教育發展提供實踐樣本。我們看到，與會嘉賓中既有高校學者、科研人員，也有中小學一綫教師、教育管理者，甚至還有來自企業界的創新力量。這種“産學研用”的跨界融合，正是 STEAM 教育蓬勃發展的活力源泉。

過去幾年，粵港澳三地在 STEAM 教育領域開展了豐富的實踐探索，取得了令人欣喜的成果。從人工智能教育課程的開發，到創客教育空間的建設；從跨學科教師培訓體系的完善，到學生創新競賽的蓬勃開展，每一次嘗試都孕育著新的可能，每一份成果都凝聚著教育工作者的心血。而今天，我們搭建起這個交流平臺，正是爲了讓這些實踐經驗得以分享與升華。在接下來的兩天裏，我們將聆聽專家主旨報告，領略前沿理論與國際視野；參與論文摘要報告和教學案例分享，感受一綫教師的創新智慧；觀摩學生學習成果展示，見證 STEAM 教育在青少年心中播下的創新火種。

各位同仁，教育是一項面向未來的事業，需要我們以更廣闊的視野、更開放的心態、更務實的行動去耕耘。在此，我們想提出三點倡議：

（一）深化跨區域協同，構建大灣區 STEAM 教育共同體—粵港澳三地地緣相近、文化相通、教育互補性强。我們應充分發揮“一國兩制”優勢，打破地域壁壘，建立常態化的合作機制——共同開發課程資源、共建共享實驗室、聯合培養師資隊伍、舉辦跨區域創新賽事，讓 STEAM 教育成爲大灣區教育一體化發展的亮麗名片 。

（二）强化科技賦能，探索 AI 與教育融合的新路徑—AI 不僅是教學工具，更是推動教育變革的核心力量。我們要積極探索人工智能在個性化學習、智能評估、跨學科教學等領域的應用場景，例如利用大數據分析學生的學習軌迹，爲每個孩子定制專屬的學習方案；通過虛擬現實、增强現實技術打造沉浸式學習體驗，讓抽象的科學原理變得觸手可及。同時，也要警惕技術异化，堅守教育初心，讓科技真正服務于人的全面發展

（三）聚焦學生成長，培養適應未來的創新人才 STEAM 教育的最終目標—我們要尊重學生的主體性，鼓勵他們在真實情境中發現問題、解决問題；要打破學科邊界，引導學生從多維度思考問題，培養跨界整合的能力；要注重培養學生的倫理意識和人文情懷，讓科技創新始終閃耀人性的光芒。

各位嘉賓，這次大會既是一次成果的展示，更是一個新的起點。讓我們以本次會議爲契機，攜手並肩、砥礪前行，在 AI 時代的浪潮中勇立潮頭，共同書寫粵港澳 STEAM 教育的新篇章！

組織委員會共同主席
朱嘉添先生（香港電腦教育學會）

我謹代表香港電腦教育學會全體顧問及理事，歡迎粵港澳大灣區的教育工作者、校長及老師參與第三屆粵港澳促進 STEAM 教育大會。

香港電腦教育學會已成立超過 44 年，一直以來致力推動本港中學、小學及特殊學校的資訊科技及電腦科的發展。為配合國家推動創新科技教育，本會聯同華南師範大學以及香港中文大學一同主辦是次會議，期望本次會議能聚集粵港澳的教育工作者，共同為 STEAM 及人工智能教育作出分享與貢獻。

本會在籌辦過程中，積極聯繫內地、澳門以及本地的中小學校長及教師，鼓勵各地教師分享教學研究及實踐教學經驗，以促進各地專業交流。同時，我們希望透過此次會議，講好香港故事，讓香港的優質教育得以發揚光大。此外，我們亦聯同各地學校舉辦教學成果分享展覽，為師生創造互相交流學習與觀摩的平台。

在此，我衷心感謝香港教育局及其他支持機構的鼎力支持，讓我們成功推動本次大會。希望藉此機會，讓大家繼續投入人工智能教育的發展行列，為一眾學子謀求福祉。再次感謝各位的蒞臨，期望大家在本次大會中有所收穫，滿載而歸。

三、會議論文摘要

數位孿生教室環境建構：結合 IoT 與 AI 提升遠距教育互動品質之研究

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[1] 香港大學工程學院電機電子工程系
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【摘要】在遠距教育日益普及的背景下，學習互動品質成為影響教學成效的關鍵因子。本研究以社會建構主義學習理論與認知負荷理論為理論基礎，設計一套融合物聯網（IoT）與人工智慧（AI）技術的數位孿生教室系統，強化遠距教學中的即時互動機制與學習參與度。社會建構主義強調學習須透過社會互動與情境脈絡建構意義，而認知負荷理論則協助系統介面設計與資訊編排，避免造成學生與教師的認知負擔，提升學習效率與專注力。

整體系統由三大模組構成：IoT 感測模組即時擷取學生視線、姿勢與操作行為；AI 分析模組預測注意力與困難點；數位孿生介面則將學習狀態即時可視化於虛擬教室中，支援教師即時決策與教學干預。

本研究採準實驗設計，招募兩所大灣區中學共 100 名學生，隨機分配為實驗組與對照組，進行為期八週的遠距 STEAM 課程介入。為排除初始差異對實驗結果的干擾，於介入前實施三項前測工具：學習投入量表、學習成果評估與互動感知問卷，確認兩組在關鍵變項上無顯著差異。實驗組使用本研究開發之數位孿生教室系統，對照組則使用標準視訊會議平台進行課程。

實驗結果顯示，實驗組學生在學習投入、學習成果與互動感知等三項核心指標上，均顯著優於對照組。教師普遍認為該系統有效提升遠距教學互動的即時性與準確度，降低教學盲區與反饋延遲問題。

學生亦表示透過視覺化互動介面，感受到更高的參與感與教師關注，進而促進主動學習與情感投入。研究結果驗證數位孿生教室在遠距互動品質提升上的潛力，並為智慧教學環境的發展提供技術架構與實務依據。未來可進一步優化 AI 推理模型與介面設計，以擴展其應用於多學科與大規模教學場景。

【關鍵詞】數字孿生；物聯網；人工智慧；遠距教育；智慧學習環境

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探讨生成式 AI 在中小学科研教育中的启发式应用模式

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【摘要】本研究探讨生成式人工智能（Generative AI）在中小学科研教育（Inquiry-Based Learning，IBL）中的启发式应用潜力，旨在解决传统探究式学习中学生问题生成困难、学习动机不足与教师引导资源有限等挑战。

研究设计的 AI 支持教学系统采用探究式学习架构，涵盖四个阶段：（1）探索发现阶段，运用大型语言模型引导学生多角度探索科研主题并确立研究兴趣；（2）概念理解阶段，整合可视化工具培养学生将概念想法图形化表达；（3）创意实践阶段，利用 AIGC 结合编程化创意实践平台，支持学生将概念转化为互动原型；（4）迭代优化阶段，通过反思对话机制完善方案。系统强调“提问-实践-提问-反思-评估”循环路径，将 AI 作为整合跨媒介工具与个性化支持， 实现从概念理解到创新应用的完整学习历程。

本研究采用混合方法，在三所大湾区本地中小学招募 120 名学生，进行一学期的教学介入。实验组学生在问题创造力、假设逻辑性与方案完整性方面表现显著优于对照组（$p<0.01$）。质性分析显示，系统的渐进式引导有效支持学生提出开放性问题并展现跨学科思维。

本研究证实生成式 AI 应用于中小学科研教育的可行性与有效性，并提出三项教学设计原则：一、构建以问题驱动为核心的 AI 互动脚本；二、设计具多样性与开放性的提示引导；三、融合教师与 AI 双重引导以发挥人机互补优势。未来将扩展至自然与社会科学等学科，进一步探索 AI 个性化引导与学生创新表现之间的关联，持续优化智慧学习环境设计。

【关键词】生成式 AI；科研教育；问题导向学习；启发式教学；智慧学习环境

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大学生人工智能素养量表的初步编制

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【摘要】本研究旨在开发并验证“人工智能素养量表”用于评估大学生的人工智能素养水平。研究采用混合方法论，结合自上而下和自下而上的方法，确保理论严谨性和实证相关性。在自上而下的过程中，研究对现有的人工智能素养框架和测量工具进行了广泛的文献回顾（Han & Zhang, 2025; Ng et al., 2021, 2024），以确定理论维度。同时，自下而上的方法通过对 58 名参与者进行开放式问卷调查，运用主题编码提取了人工智能素养的额外维度。这一双重方法共识别出人工智能素养的 11 个主要类别，包括监管、伦理、信息与通信技术技能、知识、AI 使用、鲁棒性、动机、实用性、相关性、学习 AI 以及元认知。随后，这些类别被进一步细化为 60 个次级编码，形成了包含 68 个条目的初始封闭式问卷。

探索性因子分析利用主轴因子法和斜交旋转提取因子。分析结果识别出人工智能素养的四因子结构：能力、伦理、动机和自我效能。这四个因子解释了 59.43%的总方差，Cronbach’s α 值在 0.904 至 0.931 之间，形成了包含 26 个题项的初始量表。验证性因子分析结果表明模型拟合度尚可但有改进空间（χ^2/df = 4.419，RMSEA = 0.085，CFI = 0.917，TLI = 0.908，SRMR = 0.081）。根据修正指数，系统移除了 6 个具有高残差相关性的条目，最终形成了包含 20 个题项的最终量表。改进后的模型表现出更优的拟合指标（χ^2/df = 3.336，RMSEA = 0.067，CFI = 0.954，TLI = 0.947，SRMR = 0.065）。最终的大学生人工智能素养量表展现了良好的收敛效度和区分效度。四个因子的组合信度值在 0.905 至 0.935 之间，平均方差提取值均超过 0.65，表明收敛效度良好。区分效度通过最大共享方差值低于 AVE 值得到支持。此外，Cronbach’s α 值与最大同质性信度表明内部一致性优异。

【关键词】 人工智能素养；量表开发；大学生；因子分析；人工智能素养量表

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人工智能教育与创造性思维培养的案例分析与评价

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【摘要】人工智能技术的飞速发展正深刻重塑教育生态，培养学生高阶思维，特别是创造性思维，已成为智能时代教育的核心诉求。本研究聚焦人工智能教育作为赋能学生创新素养发展的重要路径，分析广州市中小学人工智能课程中的三个典型教学案例（《会说话的电脑》、《智能小助手》、《智能画家》），探讨人工智能教育对学生创造性思维的培养效果。

案例中，教师采用探究式学习理念，设计问题驱动、任务实践与协作学习活动，并融合人工智能技术，如语音合成、生成式 AI、AI 绘画工具等。案例一《会说话的电脑》基于情境学习理论，通过语音合成技术的应用，激发学生的探究兴趣，培养学生在解决真实问题中的创新应用能力。案例二《智能小助手》以“做中学”“用中学”“创中学”为指导思想，引导学生利用生成式 AI 设计个性化的班级文创产品，提升学生的创意构思与实践转化能力。案例三《智能画家》运用跨学科教育理念，将美术与语文知识相结合，让学生理解如何真正用 AI 辅助艺术创作，拓展学生的创新思维与表达。

研究分析表明，人工智能教育在支持性学习环境与技术赋能下，能够促进学生创造性思维的核心维度——发散思维、批判性思维及跨学科整合思维的协同发展。学生在技术支持的协作探索中不断优化创意，从而提升问题解决能力。研究启示，未来教学实验需深化对技术原理的探究式理解（TPACK），并优化教学节奏设计，以支撑学生在深度理解基础上实现更高水平的技术创新与应用。

【关键词】 中小学人工智能教育；创造性思维；探究式学习；教学案例

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人工智能对话系统在教学中的实践应用 ——“智谱清言”为智能学伴

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【摘要】在人工智能技术迅猛发展的时代背景下，国内大模型竞相涌现，AIGC 在教育领域的应用前景广阔，但教学实践中的应用与检验仍显不足。本研究依托信息化教学设计流程，聚焦“智谱清言”在教学中的实践应用，采用混合研究方法（问卷调查、课堂观察、作业分析），在武汉某 z 高校 2022 级教育技术系的 33 位学生中进行小样本数据采集。结果表明，该系统通过 RTF 模型生成思维导图显著提升了学生的知识整合效率，初步证实了其在优化教学设计、提升高阶思维训练方面的价值，为教师创新教学方法、实现个性化教学提供了有力支持。然而，本研究样本量有限，研究结论具有一定的初步性和局限性。同时，研究虽提出了相关教学策略，但对这些策略的具体实施细节和深层次因果机制的探讨仍显不足。

尽管如此，研究的实际应用价值依然显著，本研究通过课堂数据分析，检验了国内人工智能对话系统在教学中的实践应用效果，为教育机构及教师提供了具体的教学建议：一是要关注学生已有的 AI 使用水平，使用 AIGC 赋能教育教学的要因材施教；二是要善用 Prompt 指导教学，提升学生与 AI 系统的有效互动。本研究不仅丰富了人工智能对话系统在教学领域的应用案例，更为推动教育数字化转型、构建适应信息化社会的新型人才培养模式提供了实践参考。

【关键词】 人工智能；对话系统；人机协同；实证研究

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基于 AI 智能体的 HPS 教育实践探索——以《电和磁》教学为例

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【摘要】在深化科学本质观培养与教育数字化转型的双重背景下，本研究聚焦于 AI 智能体赋能小学科学 HPS（科学史、科学哲学、科学社会学）教育的实践路径，构建了“三维驱动-四阶贯通”的 AI—HPS 融合教学路径，并以教科版小学科学六年级《电和磁》课程为例进行实践。该路径通过 AI 智能体技术实现三重功能支撑：历史情境再现、哲学思辨对话、社会意义建构，分别对应科学史、科学哲学、科学社会学的教育内核。教学路径分四阶推进：历史情境沉浸，驱动科学问题生成；实验探究赋能，建构科学规律认知；伦理对话深化，解析技术社会价值；迁移创新实践，发展科学核心素养。实践表明，该路径显著提升了学生课堂参与度和互动学习效果，凸显了 AI 智能体在变革传统科学教学中的关键作用，为 HPS 理念在小学课堂的实施及数字化时代科学教育创新提供了新视角与可行策略。相关启示涉及整合 HPS 教育与 AI 智能体，优化教学设计；工具思维强化实践，协同构建探究闭环；建立评估和反馈机制，持续改进教学实践。

【关键词】 HPS 教育；AI 智能体；电和磁；小学科学

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国家中小学智慧教育平台影响科学教师数字化应用能力发展的路径研究——以粤港澳大湾区为例

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【摘要】《基础教育课程教学改革深化行动方案》等文件强调要加强科学类学科教学，推进数字化赋能教学质量提升，但在教育实践中，仍面临着科学教师队伍建设亟待加强的瓶颈问题。国家中小学智慧教育平台（以下简称“平台”）作为教育数字化转型的重要抓手，经过多轮迭代优化，已于 2025 年 3 月发布平台 2.0 智能版，为教师教育教学和专业发展提供了数字支撑，但平台应用如何赋能科学教师能力提升的路径尚未明晰。为此，本研究首先参考《教师数字素养》标准和相关文献，界定了教师数字化应用能力与平台构成要素。其次，整合 TOE 框架、UTAUT 模型、自我效能感等理论，初步构建包括感知易用性等 11 个研究变量的影响因素假设模型。之后，面向粤港澳大湾区科学教师发放问卷，综合运用结构方程模型（SEM）、模糊集定性比较分析（fsQCA）等方法检验假设模型，探讨影响因素的组合效应对数字化应用能力的综合影响，并基于结果提出应用平台提升科学教师数字化应用能力的具体建议。研究发现，平台对科学教师数字化应用能力的影响呈现“条件适配—意愿激活—行为驱动—能力进化”的递进式路径，具体表现为：第一，使用意愿的激活非单一因素驱动，而是受到“技术—组织—环境”三角驱动影响。其不仅依赖于硬件设备、资源工具等条件的适配，还需通过外部组织支持、社群影响与教师个体因素协同联动。第二，行为向能力转化并非线性过程，而是受“障碍—赋能”动态博弈影响。通过对路径归类，发现多个导致科学教师高与非高数字化应用能力的组态。研究通过混合研究，揭示了平台规模化应用中多重因素对科学教师数字化应用能力的影响，弥补了传统回归分析的线性思维局限，为优化平台应用机制，推动粤港澳大湾区科学教师教学数字化转型提供了实证依据。

【关键词】 国家中小学智慧教育平台；科学教师；数字化应用能力；组态路径；粤港澳大湾区

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大型語言模型融入小學寫作教育：以 ChatGPT 輔助學習為例

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【摘要】隨著人工智慧技術快速發展，大型語言模型（LLMs）在教育領域的應用潛力備受關注。本研究聚焦於將 ChatGPT 融入小學寫作教學，探討其提升學生創意表達與寫作能力的效果。

研究採用設計型研究法（Design-Based Research, DBR），於一所小學進行為期一學期（8 週）的教學實驗。研究對象為 90 名四、五年級學生，隨機分為實驗組（45 人，使用 ChatGPT 輔助學習）與對照組（45 人，採用傳統教學）。實驗組學生在常規寫作課中，針對特定主題（如環保、未來城市等記敘文），使用 ChatGPT 獲得主題啟發、詞彙建議與結構指引，並在教師引導下進行反思與改寫。

研究資料包括學生前後測寫作作品、 創造力測驗 （ Torrance Tests of Creative Thinking）、問卷及訪談。結果顯示，實驗組學生在創意表達、詞彙運用及敘事組 織等面向均明顯優於對照組。問卷結果指出，八成以上學生認為 ChatGPT 能提升寫作興趣，並肯定其學習輔助價值。然而，部分學生亦反映過度依賴 AI 可能影響原創思考， 凸顯在教學中應加強 AI 倫理及自主創作意識的培養。

質性分析進一步指出，ChatGPT 有助降低學生構思焦慮，提供即時支援，增強學習自信心。在教師引導下，學生逐步建立對 AI 生成內容的辨識、批判與改寫能力，實現人機協作的學習模式。本研究驗證了大型語言模型在小學寫作教育中的應用潛能，並提出 AI 教學應融合創意支持與批判訓練、創作自由與技術輔助的平衡設計，以及 AI 素養的長期培養策略。

本研究對促進人工智慧與基礎教育融合、提升學生 21 世紀技能具有實證價值， 並為未來智慧教育的設計與實踐提供參考框架。

【關鍵詞】人工智慧教育; 大型語言模型; ChatGPT 小學教育; 寫作能力

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Breaking the Boundaries of Traditional Vocabulary Learning: The Impact of Intelligent Interactive Companion based Bocabulary Learning Methods on Learning Outcomes, Motivation, and Flow Experience in CAVL Environment

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Abstract: Vocabulary acquisition is the foundation of language learning, and Computer Assisted Vocabulary Learning (CAVL) environments provide new possibilities for improving learning efficiency. However, while traditional CAVL methods offer learners convenient learning channels, they still have obvious limitations in personalized interaction, contextualized learning, and multimodal presentation (Jeon et al., 2021; Yang et al., 2022). These limitations not only affect learning efficiency but also easily lead to insufficient learning motivation and poor memory retention. To address the above issues, this study proposes an Intelligent Interactive Companion for Vocabulary Learning (IIC-VL) method. This method integrates multi-agent systems, multimodal interactive interfaces, and contextualized learning strategies, capable of dynamically adjusting learning content based on learners' proficiency levels, learning styles, and emotional states, and constructs a comprehensive vocabulary learning ecosystem covering pre-class, in-class, and post-class phases. In the pre-class phase, the IIC-VL system evaluates vocabulary already mastered by learners, generates contextual examples matching learners' vocabulary levels, and establishes personalized vocabulary learning profiles. In the in-class phase, the system automatically generates teaching suggestions and instructional materials based on teachers' pedagogical objectives, and creates matching learning paths for each learner, guiding them to complete learning tasks gradually according to cognitive gradients. In the post-class phase, the system customizes personalized vocabulary review plans for each learner to consolidate long-term memory. Meanwhile, the IIC-VL system conducts multidimensional correlation analysis of classroom performance data with pre-class and post-class data, generating visualized results such as learners' vocabulary ability growth curves and learning strategy assessment reports. To validate the effectiveness of the IIC-VL method, this study adopted a quasi-experimental design, recruiting 100 students from a high school and randomly assigning them to an experimental group (n=49) and a control group (n=51). The experimental group used the IIC-VL method for vocabulary learning, while the control group used traditional CAVL environments. Both groups had identical learning content and were taught by the same teacher with over ten years of English teaching experience to ensure consistency in teaching factors. The intervention lasted 12 weeks, with two learning sessions per week, each lasting 45 minutes. Learners took vocabulary baseline tests in the first week, familiarized themselves with their respective learning environments in the second week, conducted vocabulary learning for the subsequent 8 weeks, and spent the final two weeks on performance evaluation, questionnaire completion, and semi-structured interviews. This study employed one-way analysis of covariance (ANCOVA) to evaluate differences in academic performance and learning motivation between the two groups of students, and used independent samples t-tests to analyze flow experience scores between the two groups. Results showed that, benefiting from the targeted support of the IIC-VL method, compared to the control group, the experimental group demonstrated significant improvements in vocabulary tests (both receptive and productive), learning motivation, and flow experience. Subsequent semi-structured interviews further revealed students' positive evaluations of the IIC-VL method in terms of knowledge retention, technological advantages, learning path optimization, and learning experience enhancement. These findings not only provide empirical support

for the application of multi-agent technology in CAVL environments but also offer new practical directions for personalized learning path design in foreign language vocabulary instruction. This study expands the boundaries of traditional CAVL theory while providing important theoretical perspectives for understanding how emerging technologies reshape language learning experiences.
Keywords: Computer-assisted vocabulary learning, Forgetting curve, Multi-agent system, Flow experience, Personalized learning

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The study of incorporation of Spin Photo Object as an instruction tool on Student Learning Outcomes and Learning Motivation in hands-on activity of Maker Education in Secondary 2 from Hong Kong

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Abstract: Teachers often prefer to retain students' creativity by choosing not to provide detailed instructional guidance when conducting Maker activities. Different learning materials are selected for students to facilitate self-learning which aims to encourage them to unleash their creativity and produce unique and innovative works. However, a common issue arises when the self-learning materials are insufficient to assist students in completing the required tasks. This may happen when the materials do not align well with the learning objectives or fail to clearly present the necessary information.

The researcher integrated Spin Photo Object, a user-controlled spinnable photo technology commonly used in online shopping to display product details, into a Secondary Two Maker Education course in Hong Kong as part of self-learning materials. This study will compare the learning outcomes of two groups of students: one group using Spin Photo Object with instructional videos, and the other group using still photos with instructional videos. The teacher evaluation form design is categorized into four distinct components: Design, Craftsmanship, Functionality, and Creativity (Lundberg & Rasmussen, 2018; Marshall & Harron, 2018; Huang & Jong, 2020).

Additionally, based on Keller (2010) motivation theory, this study will compare the two groups to examine differences in learning motivation. It primarily includes four motivational elements: Attention, Relevance, Confidence, and Satisfaction (ARCS). The ARCS questionnaire is a 5 point scale, with its design adapted from research on students' motivation for different fieldwork study contexts (Jong, 2020).

To obtain an in-depth understanding of students' learning experiences, the researcher randomly selected four students from each of the experimental and control groups for interviews. The interviews focus on the students' views of the self-learning resources and the challenges they encountered. Furthermore, researchers visited the school on four different occasions to observe the class to observe how students solved problems encountered during the maker activity and how students utilized Spin Photo Object and traditional photographs to find the appropriate solutions.

A total of 56 students (n=56) were successfully participating in this research. These 56 students were separated into two groups. Half of them belonged to the experimental group (n=28) and the remaining half belonged to the control group (n=28). The participants were also manipulated in the mix with lower and higher abilities students which according to their last year's final examination results.

The research findings indicate that utilizing Spin Photo Object as self-learning material may have a positive impact on the "functionality" ratings from teacher evaluation. The mean score of functionality is 2.625 and 1.875 in the experimental group and control group respectively. However, there is a very slight difference (0.125) in the total mean score between the experimental group (M=12.520) and the control group (M=12.125). Even when comparing high-ability and low-ability students separately, similar results can be observed.

An independent sample t-test was used to compare the average score for the 4 elements of ARCS separately. Regarding the elements of attention and confidence, the results demonstrate more pronounced positive outcomes. The mean difference is 0.829 with Cohen's d is 1.534 and 0.621 with Cohen's d is 0.812 of attention and confidence respectively.

The researcher also observed that the students from experimental groups always utilize the Spin Photo Object to find solutions to various problems successfully. On the other hand, the students in the control group seldom observed the ordinary still photos to find the details and primarily relied on repeatedly watching the instruction videos.

Finally, the researcher's experiences, challenges, and suggestions regarding the use of Spin Photo Object as a teaching material are discussed to inform future educational practice.

Keywords: Spin Photo Object, Instruction tool, Motivation, Maker Education, STEAM

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生成式人工智能工作流对中学生批判性思维和创新思维的影响研究——基于 STEAM 教育项目的实证研究

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【摘要】生成式人工智能（GAI）的教育研究展现出其在教与学方面的巨大潜力，但现有研究在 GAI 对学生批判性思维和创新思维的影响方面存在矛盾结果（Farrokhnia et al. 2024; Lo et al., 2024; Mohamed, 2024; Vargas-Murillo et al., 2023; Zhang & Tur, 2023），亟需更多实证研究。本研究认为，当前 GAI 工具在交互设计上存在信息输出完整性抑制学生深度思考、单一智能体功能局限与教学干预嵌入匮乏等固有局限，导致其对教学产生负面影响。为此，本研究构建了基于设计思维模型的多智能体工作流，其中，智能体扮演目标用户或导师引导学生完成 STEAM 项目，包括绘制同理心地图、定义问题、构思方案、设计原型与测试。本研究选取中国南部沿海发达城市某中学 20 名高一学生为对象，采用混合研究方法，开展 5 天密集型 STEAM 工作坊进行实证研究，共计 32 小时，分十组，每组两人。研究针对批判性思维效能感和创新思维效能感发放前后测问卷，并以小组为单位进行一小时左右半结构化访谈。问卷结果显示，学生自我报告的批判性思维效能感和创新思维效能感均值均有提升，Wilcoxon 符号秩检验表明学生创新思维效能感提升具有统计显著性且效应量中等。访谈数据表明，学生认为 GAI 工作流在受众群体确定及方案设计等初期阶段能起到良好的辅助作用，能够激发或完善其想法。与此同时，学生意识到 GAI 可能给出错误或不切实际的方案，需自身具备批判性思维辨别筛选，也认识到 GAI 难以产生创新想法及缺乏对用户需求的情境化理解，从而培养自身的创新思维能力。此外，学生提到独立思考及提示词工程撰写能力的重要性。研究结果表明，GAI 工作流支持下的 STEAM 教学是值得尝试的教学探索，但本研究存在样本规模较小、被试学业水平偏高可能造成结果偏差的局限性，未来研究可扩大样本容量及范围，关注学业水平中等或以下群体的干预效果以丰富研究发现。

【關鍵詞】 STEAM；生成式人工智能工作流；批判性思维；创新思维；中学生

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Supporting Students to Create Virtual Reality Content: Evidence from Primary Classrooms

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Abstract: **Background:** Maker education has increasingly gained attention in recent years, and with it, the need to involve youth in the responsible use of technology (Hwang, 2023). The use of VR content creation as learning assistants is receiving increasing attention in maker education and collaborative learning, as they are able to collaborate with students using their prior knowledge. McGivney (2025) and previous reviews mainly focused on only one or two narrow aspects of VR use in maker education. This study goes beyond merely reporting the specific types of maker education employed in previous studies and examines how VR content creation supports learning in education. This paper reports on a pilot study where primary school students created 360° VR learning resources.
Aims: The purpose of this study is to discover the possible technological, pedagogical, and social affordances enabled by VR content creation in primary education.
This research has two objectives: 1) to examine the contributions of primary school students' motivation and perceived teachers' support about maker education, especially in VR content creation, and 2) to examine the attitudes and difficulties that students encounter in implementing VR content creation in primary education.
RQ1: How can VR content creation be implemented in primary education?
RQ2: What attitudes and difficulties did the students encounter in implementing VR content creation in primary education?
Materials & Methods:
In this study, our research team leverages a low-tech VR content creation platform to teach primary school students how to create VR stories as part of an environmental conservation project. The participants were primary four to primary six students, who used tablets and an online VR creation platform to create VR stories about the ecosystem. A total of 91 students from 12 schools took part in the study, and valid survey responses were collected from 85 of them.
This research adopted a quantitatively-driven mixed-methods research design, which involved pre- and post-tests, observation of participants, and in-depth semi-structured interviews to collect the data for this study. While technical set-up and time constraints affected the research, primary school students generally enjoyed the experience, with the facilitators observing good levels of engagement. It will illuminate the frameworks created for student participation at the primary school level, i.e., field trip, campus workshop, and VR content creation workshop, and how students' view of the collaborative learning, digital literacy, and understanding of VR.
Results: This study outlines the findings and examines primary school students' perceptions in creating VR content. The findings of this empirical and theoretically grounded study are expected to critically engage with the discussions of students' participation as the positioning of learners' needs in frameworks like the human relations approach in primary education. Our findings revealed three technological affordances: timeliness, ease of use, and personalization. Maker education appeared to encourage students' social presence through affective, open, and coherent communication. Several challenges in using VR content creation were identified: technological limitations, the novelty effect, and cognitive load. The results also indicate that the maker activities should be carefully designed so that students can realise the meaning of the activities.

Discussion and Conclusion: This study shows the importance of empowerment in developing primary students' attitudes and skills in maker activities. In fact, there was no increase in the content knowledge of primary school students after viewing the VR learning resource, but most reported good system usability. The pilot study indicated that having students create learning content for an authentic audience, such as their schoolmates, is feasible with the potential to generate positive learning outcomes if organizational and time constraints can be addressed.

This context has led to a rise in teaching innovation and the adoption of technology-enhanced learning in education. This shift involves creating personalized, technology-enriched learning experiences to equip students with the necessary knowledge, skills, and competencies to succeed in the 21st century (Petersen et al., 2023). Therefore, there is a growing call for students to re-conceptualize their role as creators and create effective learning experiences and learning environments.

The intention of this study is to understand students' perceptions towards maker education, which is significant for discussing the development of digital literacies for future readiness. Findings of this study provide insights into primary students' perception of maker education and its effectiveness in developing collaborative skills for academic purposes. The findings may assist education practitioners to consider a more effective task that could meet the needs of primary students in this digital age, enabling primary school students to engage with and become part of the digital community.

Keywords: Virtual Reality Content Creation, Primary Education, Maker Education, STEAM Education, human-computer interaction

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Experiential learning with assembly robots: Supporting student self-efficacy, collective efficacy, and collaborative problem-solving

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Abstract: In the context of STEAM education, students are increasingly expected to demonstrate interdisciplinary knowledge, as well as collaboration and problem-solving skills. These demands could be challenging, especially for those with low confidence in understanding and applying technical concepts. Moreover, teamwork and efficacy are critical to success in the high-tech workplace of the 21st century (Leavy et al., 2023). To address these needs, the present study examined the effects of experiential learning with assembly robots on students' self-efficacy, collective efficacy, and collaborative problem-solving (CPS) skills.

A four-week intervention was conducted in April 2025 with 30 graduate students from diverse backgrounds (e.g., Architecture, Engineering, Mathematics, and Management) at a public university in Hong Kong. Students were divided into six groups, each of which had at least one member with previous experience in assembly robotics. The intervention included weekly group discussions and two hands-on tasks involving the programming and operation of robotic arms.

This study aimed to (1) examine the impact of working with robotic arms on students' self-efficacy, collective efficacy, and academic achievement, (2) identify students' use of CPS strategies, and (3) explore students' perceived benefits and challenges of robot-integrated STEAM learning.

A mixed-methods case study design was employed. Quantitative data included pre- and post-surveys on self-efficacy (adapted from Pintrich et al., 1993) and collective efficacy (adapted from Wang & Lin, 2007), knowledge tests, and two hands-on tasks. Qualitative data included group discussions, student-robot interactions, open-ended surveys, and semi-structured interviews.

In terms of efficacy outcomes, Wilcoxon signed-rank tests showed no significant pre-post changes in self-efficacy ($p = .543$) or collective efficacy ($p = .448$) at the class level ($N = 30$), nor at the group level, although two groups showed an upward trend and one declined. Midpoint comparisons (against the scale midpoint of 4) revealed post-survey collective efficacy was significantly above midpoint ($p < .001$), but self-efficacy was not ($p = .053$). At the group level, one group showed a significant increase in self-efficacy ($p = .011$) and four groups showed an increase in collective efficacy ($p < .05$). These results indicate an overall enhanced efficacy, with variability among groups and collective confidence being stronger than individual confidence. In the pre-test, none of the students' self-efficacy ratings were significantly above the midpoint, which could indicate a neutral baseline that improved after experiential learning with the assembly robots in the group.

Observations of group discussions and student-robot interactions during hands-on activities revealed students' CPS strategies, including task division, peer feedback, and process monitoring. These behaviors indicate their active coordination, communication, and shared cognitive regulation.

Open-ended surveys and interviews further supported these findings, with students emphasizing the benefits of integrating interdisciplinary knowledge with hands-on application, enhanced collaborative learning through group problem solving, and increased motivation for STEAM careers. They also highlighted challenges, particularly the need for multiple learning supports (e.g., virtual simulations) and onboarding resources. These suggestions point to the importance of individualized scaffolding in collaborative learning.

Ongoing analyses of student performance on knowledge tests and hands-on tasks will be presented at the conference. Strategies for instructional design will be shared with educators and researchers, focusing on the reflective integration of assembly robots into experiential learning and the design of personalized scaffolds for interdisciplinary tasks.

Keywords: Assembly robot; human-robot interaction; collaborative problem-solving; experiential learning

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國際學校 STEAM 教育的教學實踐與挑戰研究

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【摘要】本研究在一所獲授權提供加拿大亞伯達(Aberta)課程的國際學校內進行，廣泛應用於國際教育體系中。研究聚焦於多元文化與國際課程框架下，教師在推行 STEAM 教育時所面對的挑戰與困境。教師在實施過程中需處理的不僅是學科知識的融合，還包括學生背景多元、教學語言差異等層面的複雜性。因此，國際學校的教育現場提供了一個觀察與分析此類挑戰的理想場域。

本研究採用質性研究方法，旨在探究教師在科技、教學與內容知識（TPACK）(Koehler et al., 2014)能力。研究對象為四位來自澳門國際學校的外籍教師，透過半結構式深度訪(Rubin & Rubin, 2011)談蒐集資料。所有訪談過程均經錄音並逐字轉錄(Gibbs, 2018)，以確保資料的完整性與準確性。參與者皆積極參與 STEAM 相關教學，並具備豐富的實務經驗。研究從教師視角出發，深入剖析其在實施 STEAM 教育過程中所面臨的主要挑戰，包括教學設計、學科整合、學生差異化需求、資源配置以及時間管理等層面。

研究顯示，教師在國際學校 STEAM 課程中面臨整合上的多重挑戰。教師須掌握快速變化的科技以實踐專案學習，教學上則需要設計符合多元學生需求的跨學科活動。此外，教師需運用數位工具提升學生的問題解決能加和合作能力等。然而，真正困難在於，教師須在語言障礙、多元文化與不同學科中協調各項知識。有效實施需倚賴學校的政策協調、提供專業發展與彈性課程設計支持，幫助教師在教學中靈活運用科技、教學與學科知識。

【關鍵詞】 Aberta 課程；STEAM；教師專業發展；跨學科教學；學科知識

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创客教育让非遗“智美”起来——区域非遗创客教育生态体系建设之十年探索

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【摘要】本研究针对学校开展跨学科融合及非遗课程的困难和短板，系统探索将非遗项目与科技创新进行深入融合发展，形成具有地方特色的非遗课程并体系化推进，落实“五育并举”，培养学生的乡土情怀、审美能力和社会责任感，促进创新精神与实践能力的发展。构建了创客教育生态体系，提供跨学科创新学习的完整保障链。形成了包括机制创新、环境建设、课程构建、学生成长等环节的创客教育生态链，解决教师队伍培养、教学环境搭建、教学内容设计等开展学科融合创新教育所遇到的一系列实际问题。凝练了技术赋能传统文化传承与创新的教育特色，提供可普及、可推广的非遗创客课程。探索了“感知-探究-创作”3C 创客教学模式，提供基于非遗的跨学科项目式学习实践路径。
【关键词】非遗创客；教育生态体系；技术融合；文化传承

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The Integration of VR into Junior High School History Education

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Abstract: With the rapid development of digital education, virtual reality (VR) technology, characterized by its immersive and interactive features, has brought revolutionary opportunities to traditional teaching models. Junior high school history education has long relied on static teaching methods such as texts and images, leading to insufficient intuitiveness, low student engagement, and challenges in contextualizing historical events. Guided by cognitive load theory and multimedia learning theory, this study explores the integration of VR technology into junior high school history curricula. Through experimental comparisons between an experimental group and a control group, combined with pre-tests, post-tests and survey questionnaires, the study evaluates the impact of VR technology on students' interest and comprehension skills.

First, this study analyzes the research status of virtual reality (VR) technology in education both domestically and internationally, and systematically summarizes the theoretical foundations for applying VR technology to junior high school history teaching. Second, it designs the curriculum "The Old Summer Palace – A History from Glory to Destruction" and its virtual learning scenarios, implementing them in teaching experiments with junior high school students recruited from several middle schools in Jiangsu Province. Through a comparative teaching design involving an experimental group and a control group, combined with questionnaire surveys and quasi-experimental research methods, the study evaluates the impact of VR technology on students' learning interest and comprehension abilities.

Based on the empirical analysis, this study concludes the following: at the level of students' interest in history learning, the interactivity and immersiveness of VR technology effectively reduces the cognitive load, breaks the abstractness of historical knowledge, and stimulates students' intrinsic curiosity and exploratory power in history. At the level of visualization of historical events and concepts, VR technology is especially helpful in explaining concepts that are difficult to be visualized in the traditional classroom, so that the teaching content can be more easily absorbed and internalized by students. In terms of the depth of historical understanding, VR technology promotes students' deep understanding of historical events through contextualized learning paths. This study provides a practical example of the application of VR technology in the humanities, as well as theoretical support and methodological reference for the innovation of junior high school history education and the promotion of educational equity.

Keywords: Virtual Reality (VR); Junior High School History Education; Cognitive Load Theory; Immersive Learning; Teaching Model Innovation

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基於智能閱讀應用程式對小學學生語文閱讀能力影響的實證研究—以廣東省某小學五年級學生為例

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【摘要】近年來，智能閱讀應用程式已逐漸應用於小學語文閱讀教學中 (Chen et al., 2020; Yang et al., 2022) ，然針對其是否能有效提升小學高年級學生閱讀能力之實證研究仍付闕如。為回應此研究缺口，本研究基於建構主義學習理論 (D.C.P., 1979) ，建構「課前個性預習—課中協作探究—課後拓展遷移」之智能教學模式，探討科技賦能下學生語文閱讀能力提升的實踐路徑。

本研究以廣東省梅州市某小學五年級兩個平行班為實驗對象，其中實驗班與對照班各 30 人，對照班採傳統閱讀教學，實驗班則使用基於「一米閱讀」應用程式的智能教學模式，實施 12 週的教學干預。該應用具備依學習者能力推薦閱讀文本、遊戲化測試、即時反饋與閱讀報告等功能，支援教師進行全流程之個別化教學。課前可推播預習任務，課中提供互動練習與即時檢測，課後則協助教師追蹤學習歷程與成效，促進學生閱讀能力發展。

本研究透過問卷調查與教師深度訪談收集資料，並以配對樣本 *t* 檢定分析兩組學生前後測表現。結果顯示，實驗組在認讀感知、理解等能力維度之雙側 *p* 值均小於 0.001，反映智能教學模式有效提高學生各維度之閱讀能力，並呈現縮小學習差距之趨勢。教師訪談亦印證了智能應用程式於提高閱讀能力之正向作用。然而，問卷數據及訪談結果共同揭示，智能應用在深層閱讀如運用、評價等能力維度支持有限，其尚未能充分支援深層閱讀能力的培養，未來應融合人機互動與教師引導，實現閱讀能力之全面發展。

本研究驗證了智能閱讀應用程式於語文課堂中提升學生閱讀能力之潛力，並指出其於深層閱讀支持之不足。建議未來可強化即時回饋、歷程記錄等機制設計，深化學生運用與評價能力，實現智慧科技由工具性支援走向學習導引之轉化，推動語文素養在人工智慧時代下的全面發展。

【關鍵詞】小學語文；閱讀能力；個性化學習；技術賦能

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大模型智能体赋能小学信息科技项目式学习的设计与实践研究

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【摘要】随着 AI 时代的到来，生成式人工智能技术迅速发展，相较于通用生成式人工智能在开放域对话中的泛化能力，大模型智能体凭借其在教育场景中更精准的反馈能力和动态知识库构建能力在教学中展现出巨大潜力。本文基于项目式学习理念，探索如何通过大模型智能体赋能小学信息技术课堂中的教学与实践，旨在促进学生的自主探究、协作学习与计算思维等高阶能力与核心素养的发展。本研究，结合真实课堂情境，开发并部署一个智能体系统，支持学生在学习过程中进行任务理解、问题解决和反思调控。研究过程中采集教学观察记录、学生学习成果、学生与智能体对话记录等多源数据，进行综合分析。结果表明，基于大模型智能体的教学设计有助于提升项目式学习的实施效率与教学互动质量，能够有效支持学生的学习过程和个性化发展。研究亦揭示了教师在应用人工智能工具时所面临的挑战与专业支持需求，提出了未来小学课堂中人机共教的新思路与实践方向。
【关键词】大模型智能体；项目式学习；教学模型；人工智能教育应用

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作文自動評價系統 (AWE) 在高校英語寫作教學中的應用研究——以廣州某高等院校為例

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【摘要】當代高校英語寫作教學面臨教師回饋人力有限、評改效率與針對性不足等挑戰 (Ding & Zou, 2024; Ngo et al., 2022)，為此，如何借助人工智慧提升寫作教學成效，已成為當前研究熱點 (Yang et al., 2023)。現有研究多聚焦作文自動評價系統 (Automated Writing Evaluation, AWE) 之技術層面或單次應用效果，對其在長期課堂教學中與教師反饋的差異性影響尚缺乏系統實證 (Barrot, 2023)。基於此，本研究建構了基於批改網作文自動評價系統之高校英語寫作批改反饋方式，並以廣州某高等院校為例，探討了作文自動評價系統在高等教育英語寫作教學中之應用成效。透過比較作文自動評價系統反饋與教師反饋對學習者寫作能力提升的差異，分析兩者對學習者寫作表現之多維影響，涵蓋成績、詞彙、語法、語篇等核心構面。

研究採用前後測寫作成績比較和問卷調查法，選取 100 名大學本科英語學習者，其中對照班和實驗班各 50 人。對照班接受傳統教師反饋，而實驗班接受批改網自動評價系統反饋。兩班學生於教學介入階段共完成 3 次正式寫作任務與修改練習。透過配對樣本 *t* 檢驗分析結果顯示，實驗班學生後測成績顯著優於前測，雙側 P 值小於 0.001，對照班亦有提升，但幅度較小，差異不具統計顯著性，顯示批改網作文自動評價反饋在提升學生寫作成績方面具有顯著效果。此外，問卷調查結果顯示，大部分學生對自動評價系統在詞彙、語法、反饋速度、具體性與及時性表示滿意，但在語篇、思想立意層次建議方面，批改網作文自動評價系統之建議略顯機械化，部分學生仍偏好教師提供的個性化反饋，反應現行技術於高階寫作能力培育之侷限 (Shi & Aryadoust, 2024)。學生普遍認為，將教師反饋與自動評價系統結合使用，能夠在提高寫作能力的同時，促進對語言規則的深層理解。

本研究之結果希冀為高校英語寫作教學提供實證依據，並為自動評價系統的改進與推廣提供具體建議，未來研究可進一步探討人機共評模式在語篇結構與論證邏輯方面的應用潛力，以完備人工智慧時代之外語寫作教學理論體系。

【關鍵詞】作文自動評價系統；高校英語寫作；教師反饋；教學效果

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Group Mind-Mapping Mnemonics (GMMM): AI-Powered Tools to Extend Interactive Learning Beyond the Classroom

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Abstract: After formal lesson time, many students revert to passive rote review strategies, significantly weakening the impact of interactive pedagogies used during class hours (Chi & Wylie, 2014). This disconnect between in-class and after-class learning approaches creates a critical barrier to educational effectiveness, particularly in East Asian contexts where examination preparation heavily influences study habits (Peters, 2017). To counter this tendency, the present project will develop two complementary AI-powered tools that support Group Mind-Mapping Mnemonics (GMMM): (1) a mind map analysis system that provides personalized recommendations for improving knowledge organization and visual structure, and (2) a mnemonic suggestion engine that generates customized memory aids based on uploaded mind map content. Unlike existing mind-mapping software that offers only static templates or basic formatting tools, our system employs natural language processing and knowledge graph analysis to evaluate conceptual relationships and suggest domain-specific improvements (Davies, 2011; Holstein et al., 2019). Similarly, while current mnemonic applications provide generic memory techniques, our engine generates context-aware suggestions by analyzing the semantic content and hierarchical structure of student-created mind maps, adapting to individual learning patterns through machine learning algorithms (Putnam, 2015).

Drawing on the Interactive, Constructive, Active, Passive (ICAP) framework (Chi & Wylie, 2014), these AI systems will analyze student-created mind maps and offer tailored suggestions that promote higher-order thinking. The mind map analysis tool will evaluate structural elements such as hierarchical organization, connecting relationships, and conceptual completeness, then provide specific improvement recommendations based on domain-expert principles. The mnemonic suggestion engine will identify challenging concepts within the mind maps and generate multiple memory aid options (acronyms, keyword associations, visual imagery suggestions) that students can select from, modify, or use as inspiration for their own creations (Bellezza, 1981). Both tools will support collaborative features where student groups can share, comment on, and collectively refine both mind maps and mnemonic devices.

The research methodology will proceed through three stages with integrated ethical safeguards: First, development of the AI algorithms through collaboration with subject matter experts and cognitive scientists, incorporating differential privacy techniques to protect student data and establishing transparent algorithmic decision-making processes (Holmes et al., 2022). Second, iterative usability testing with small student groups after obtaining informed consent from participants and institutional review board approval, ensuring voluntary participation and the right to withdraw. Third, a classroom-based implementation study examining how these tools influence after-class study behaviors, with continuous monitoring for algorithmic bias and regular audits to ensure equitable recommendations across diverse student populations (Baker & Hawn, 2022). Data collection will include analysis of mind map quality before and after AI recommendations, student modification patterns of AI-suggested mnemonics, collaborative discussion logs, and comparative assessment of study approaches before and after tool adoption. All data will be anonymized and encrypted, with clear data retention policies communicated to participants.

Particular attention will be paid to how these AI tools might benefit students with different learning preferences and participation styles, while maintaining student autonomy and preventing over-reliance on AI suggestions (Luckin et al., 2016). The project will investigate how varying levels of AI intervention affect student agency and learning ownership, ensuring that AI recommendations serve as scaffolding rather than replacement for critical thinking.

The study aims to demonstrate how AI-powered cognitive tools can provide scaffolded support for extending classroom dialogue into home study environments without requiring constant teacher presence. Expected outcomes include: (1) validated algorithms for mind map analysis that incorporate domain-specific knowledge structures while respecting student creativity, (2) design principles for culturally responsive mnemonic suggestion systems that respect linguistic and conceptual features of East Asian educational contexts, and (3) empirical evidence regarding how AI-mediated feedback influences the quality of student thinking during independent study. By providing intelligent cognitive support that responds to individual student needs while maintaining ethical standards, these tools aim to bridge the gap between classroom dialogue and after-hours learning, creating a more coherent educational experience.

Keywords*:* artificial intelligence in education; mind mapping; mnemonic techniques; ICAP framework; personalized learning

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促进学生计算思维发展的个性化教育游戏开发

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【摘要】在 AI 时代，计算思维作为运用计算机科学领域思想方法解决问题、进行系统设计和行为理解的关键能力（Wing, 2006），不仅是学生适应数字化社会的必备素养，更是培养创新思维和问题解决能力的核心要素。然而，当前计算思维教育面临诸多困境，如教学资源缺乏吸引力、大班教学难以满足不同层次学生的需求、算法教学难度过高致使学生学习兴趣不足、入门困难等，严重阻碍了学生计算思维的发展（张屹 et al., 2020）。

而人工智能技术能助力教师设计优质教学资源、提供精准的学情分析（蒲清平，王雪婷，2024），教育游戏能够降低学习难度、提高教学资源的吸引力、实现学生的个性化学习（张娜 et al., 2024），STEAM 教育理念能够打破学科界限（董建旭，2025），将计算思维融入跨学科项目实践，促使学生在运用算法解决实际问题的过程中，强化计算逻辑的理解与应用。基于此，本研究通过与 AI 进行协作，以 STEAM 教育理念为指导，设计了“买鸡小能手”、“叠加求助令”等跨学科项目，构建“抽象-分解-建模-算法设计-编程实现-评估-概括”的计算思维培养模式，并借助编程猫平台开发面向小学高年级学生的自学游戏资源。

经实践检验，该游戏成效显著，能够有效调动学生的学习积极性，降低算法学习难度，显著提升学生的学习兴趣，促使学生对算法学习的态度向积极方向转变，有力推动了学生计算思维的发展。此外，借助该游戏，学生能够依据自身学习节奏自主探索知识，实现个性化学习体验，体现了科技在教育领域推动个性化与自主学习的重要作用，为 AI 时代 STEAM 教育中计算思维的培养提供了创新实践，为后续教育教学改革提供了有益参考。

【关键词】计算思维；个性化学习；STEAM 教育；教育游戏

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AI 背景下个性化学习：自我决定理论视角

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【摘要】随着人工智能（AI）技术在教育领域的深度融合，个性化学习作为实现"因材施教"理想的重要途径受到广泛关注。目前研究聚焦于 AI 技术创新和认知优化，忽视了学生的心理需求和情感体验。本研究以自我决定理论（SDT）为理论基础，该理论指出当环境能够满足个体对自主性、胜任感和归属感三种基本心理需求时，内在动机将被充分激发，产生更主动、持久的自我决定行为。本研究构建了“基于 SDT 的 AI 支持下个性化学习模型”： AI 通过提供多元化学习选择、个性化路径规划、学习进度自主调控和基于偏好的资源推荐，增强学生的自主感知和自我决定性； AI 通过精准学情诊断、动态难度调适、即时形成性反馈和可视化进步追踪，为每位学习者创设“最近发展区”内的适度挑战，帮助其体验能力成长的成就感；AI 通过智能同伴匹配、在线协作平台和师生交互工具，突破时空局限，构建支持性学习共同体。基于此模型，本研究提出系统性教学策略建议：一是设计支持自主的“选择架构”，包括提供有意义的学习选择、明确教师引导者角色、支持进度自主调控；二是打造“脚手架式”反馈生态，实现人机协同的混合式反馈、强调过程性与信息性反馈、创设“安全试错”环境；三是构建“人机协同”学习共同体，以技术赋能社会性互动、设计协作核心的学习任务、强化教师的社区营造者角色。本研究试图建立技术创新与学习动机之间的理论桥梁，为教育工作者提供了设计和实施 AI 支持下个性化学习的操作框架，有助于推动智能教育从“技术中心”向“学生中心”的范式转变，最终实现技术赋能与人文关怀相统一的“以人为本”的教育愿景。

【关键词】人工智能；个性化学习；自我决定理论

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人工智能驅動下的跨學科中文教學：聲音、畫面與情意的「有聲畫字」小說繪本創作實踐

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【摘要】本研究探討將人工智能技術與 STEAM 理念融入中學中文科課程，通過「聲音、畫面與情意」多重感官交織的方式，引導學生創作「有聲・畫・字」互動式繪本。為降低技術門檻並提升創作自由度，教學設計採用 Midjourney、POE 與豆包（AI 圖像生成、文字優化）以及 SUNO（音樂創作）等 AI 平台，使學生嘗試藝術與編曲，加深批判思維與跨學科協作。研究樣本為 31 人的中三班，課後以 Google Form 回收調查問卷以及由學生製作簡報及拍片進行反思，檢定顯示學習動機、跨學科自我效能、創意表現及 AI 倫理意識的平均分。本研究立基於兩大學術框架：認知負荷理論（Cognitive Load Theory）強調分階段拆解教學任務與用科技「後台化」複雜技術，減輕學生操作負擔，使其能專注於故事結構與情感鋪陳；多元智能理論（Multiple Intelligences Theory）則教師根據學生多樣的智能面向設計活動，協助學習者在不同領域發揮創造力。

在教學實施上，教師先帶領學生閱讀不同中文小說及劇本，聚焦角色情緒與衝突等文學技巧，並讓同學活用不同文學技巧撰寫繪本內容。其後學生使用 AI 圖像生成工具生成角色與場景插畫。待圖像完成後，導入 SUNO 設計音樂，根據故事內容調整曲風與節奏。最終將文字、插畫、音樂和配音整合成互動作品，參加比賽及進行網上分享。研究顯示，此教學模式使學生能同時運用語文、藝術與科技知識，並因技術簡化而專注於人物設定與情感表達。小組協作培養了學生間想法互動與批判思考；學生也體悟 AI 工具的優勢與限制，提升對演算法與創作倫理的省察能力。

整體而言，融合 AI 平台並輔以相關理論，有效推動中文科的跨學科教學實踐。學生不僅開拓敘事與美術創作的多元思維，也培養面對 AI 時代所需的溝通、協作與問題解決能力，為人文課程結合 STEAM 框架提供新嘗試，讓我們看到語文教育可以是多元且富有科技色彩。

【關鍵詞】 跨學科協作；STEAM 教學；人工智能；多元智能；認知負荷理論

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「促進學習的回饋」：以人工智能寫作回饋（AWE）融入高中寫作教學之行動研究

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【摘要】 傳統中文寫作教學中，教師「精批細改」的回饋模式常因延遲、單向等局限而影響學習成效 。生成式人工智能（GAI）的出現為自動化寫作回饋（AWE）帶來突破，使其具備提供即時、互動及高層次內容回饋的潛力 ，然而本地相關的實證研究仍較匱乏 。本研究旨在透過行動研究，探討將 AWE 融入高中議論文寫作教學，以改善教學實踐並提升學生寫作表現的可行模式。研究對象為香港一所中學的 33 名中五學生 ，採用單組前後測設計 ，在為期三個月內實施了三個漸進式的教學循環（學生獨立使用 AWE、教師與 AWE 協作、結合同儕回饋）。研究透過寫作測驗、問卷及訪談收集數據。配對樣本 t 檢定結果顯示，教學介入後，學生的寫作總分（$t(32) = 2.955$, $p = .006$）與「內容」分項（$t(32) = 3.237$, $p = .003$）均有顯著提升，效果量達到中等水平 ，惟「表達」與「結構」的進步不顯著 。質性數據表明，學生肯定 AWE 在提升回饋效率和提供具體修改範例方面的工具價值，但對其評分準確性持保留態度，且認為其缺乏情感激勵 。研究結果呼應了促進學習的回饋（Feedback for learning）理論，即有效的回饋需具備及時性與引導性 。本研究結論指出，AWE 的成效高度依賴於教師的教學設計與引導，應建立人機協作模式，由 AWE 處理基礎回饋，教師則專注於啟發高階思維、補充情感支持及引導學生深度反思 ，這也印證了在 AWE 應用中教師角色轉型的重要性 。鑒於本研究樣本有限，未來研究應擴大樣本並納入對照組，以進一步驗證其成效。

【關鍵詞】 人工智能寫作回饋（AWE）；生成式人工智能；中文寫作；促進學習的評估；行動研究；教師角色

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生成式人工智能与思维导图融合下的高中英语文化类语篇阅读教学

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【摘要】在高中英语文化类语篇阅读教学中，传统模式面临文化内涵解析浅表化及思维训练碎片化等困境，难以有效落实“学思结合”与文化意识培养目标（教育部, 2020）。本研究基于建构主义理论（Anderson & Pearson, 1984），构建“生成式人工智能（GenAI）+思维导图”整合框架，以人教版必修一“Why do we celebrate festivals?”语篇为实践载体，探索“数据驱动—协作建构—智能反馈”三维教学路径。

在读前环节，基于自然语言处理技术分析学生的历史学习数据和 KOLB 学习风格问卷结果，充分发挥 GenAI 的个性化服务优势，依据学生知识储备与学习风格，精准识别兴趣点与知识盲区，实现精准推送中外节日（如埃及收获节、中国春节、西方万圣节等）的多元背景资料，涵盖历史起源、民俗活动等维度，同时引导学生自主绘制思维导图预测文本主题，激活先验知识，搭建文化认知的初步框架。读中创新采用“结构可视化+语言精细化”双轨模式：一方面，借助思维导图直观呈现文本脉络，清晰拆解节日起源、习俗演变、商业化现象等内容架构，使文化信息层次化、直观化；另一方面，结合 GenAI 对语言细节进行深度剖析，如探究“fade” “commercialised” 等词汇的内涵，实现语言学习与文化理解的有机融合。读后环节依托 GenAI 生成动态思维导图框架，突破传统静态模式，支持学生对节日文化进行拓展思考，如对比不同文化节日的共性与差异、探讨商业化对节日文化的影响等；同时基于《中国英语能力等级量表（2024 版）》中文学作品类阅读典型活动量表框架，由 GenAI 结合本课内容开展精准评估，实现“教—学—评”一体化闭环。

该模式将 GenAI 的智能推送、动态生成与思维导图的可视化表征深度融合，为文化类语篇阅读教学开辟新路径，以提升学生的文化意识、逻辑思维及综合语言运用能力，以期为英语教学改革提供更具价值的参考。

【关键词】生成式人工智能；思维导图；高中英语阅读教学；文化类语篇；教学模式

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教师 AI 能力框架的国际比较研究

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【摘要】本文系统探讨 GAI 时代全球教师 AI 能力框架的发展趋势与区域差异。自 2022 年 ChatGPT 问世以来，GAI 技术为教育带来效率提升与普惠机遇，许多专家学者也对全球教师 AI 能力框架进行了思考和解读，但缺乏对其系统性的整体呈现与跨体系比较。通过分析 12 项国际组织、国家及地区发布的框架，本文试图展现它们共同的关注点，同时揭示区域差异对教学实践的影响，助力 AI 时代的教师从知识传授者转型为技术实践者、教育创新者、伦理思考者。 本文调研的框架普遍遵循从基础到高阶的递进逻辑，兼顾技术、伦理与教育实践的多元融合。通过文本挖掘和关键词分析，本文发现全球视野下教师 AI 能力框架呈现四大核心能力维度：教育主体与核心要素、技术工具与应用场景、能力发展体系以及伦理与社会影响。

但是，尽管存在共性维度，本文利用 TF-IDF 算法进行区域比较后揭示了不同地区框架侧重点的显著分化：国际组织强调能力进阶、伦理风险防控与科研导向，注重教师作为技术实践者与人文守护者的双重角色，但高阶能力培训成本较高，欠发达地区落地困难；美国突出“以学生为中心”，聚焦课堂教学场景中师生互动与人机协作，可提升个性化教学效率，但过度依赖 AI 可能削弱学生独立思考能力；东亚（中日韩）重视技术落地的工具理性，强调信息处理、问题解决能力及教学实践效率，优势在于快速普及技术实操能力，但可能缺乏指引长远方向的“价值锚点”；欧盟则强调整合性与系统性思维，兼顾技术操作与人文关怀，倡导 AI 赋能下的学习路径设计与权利保障。

在未来，全球教师 AI 能力框架需继续动态纳入新兴技术维度，构建包容性能力发展体系，中国可借鉴国际经验、结合本土需求，构建兼具技术深度与教育温度的教师 AI 能力标准，为全球教师教育贡献中国智慧和中国方案。

【关键词】教师 AI 能力框架；区域差异；生成式人工智能；教师教育

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Developing an ICAP-Based Framework for Evaluating Student Engagement in Dialogic Classrooms

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Abstract: This paper presents a comprehensive theoretical framework for analyzing student engagement in dialogic teaching environments, addressing the limitations of traditional assessment methods that rely on simplistic metrics like contribution frequency or test scores. Grounded in the Interactive, Constructive, Active, Passive (ICAP) theory (Chi & Wylie, 2014), the framework integrates behavioral indicators with cognitive processing markers to evaluate engagement patterns across classroom and after-class learning activities.

The framework addresses three critical challenges in engagement evaluation: distinguishing superficial participation from genuine cognitive engagement, capturing contribution quality beyond quantity, and tracking engagement transfer between formal classroom settings and independent study. Our coding system classifies student behaviors according to ICAP categories through specific observable indicators: verbatim note-taking indicates Active engagement, self-explanation behaviors demonstrate Constructive engagement, and collaborative reasoning sequences reflect Interactive engagement (Chi et al., 2018).

The evaluation framework examines three dimensions: cognitive engagement levels defined by ICAP, dialogic participation quality aligned with Academically Productive Talk criteria (Michaels et al., 2008), and engagement pattern transfer between learning contexts. For each dimension, we propose data collection methods and analysis approaches including discourse analysis protocols for identifying reasoning chains, structural complexity assessment of mind maps, and knowledge elaboration measurement in group discussions. The framework introduces "engagement profiles" to account for how cultural factors and prior educational experiences influence participation patterns, recognizing that students from diverse backgrounds may demonstrate engagement differently (Alexander, 2020).

Key contributions of this framework include: (1) operational definitions for distinguishing passive compliance from constructive thinking in dialogic contexts, (2) systematic observation protocols and rubrics that balance comprehensive assessment with practical classroom implementation, (3) culturally sensitive indicators that acknowledge diverse engagement expressions in East Asian educational contexts (Howe & Abedin, 2013), and (4) a theoretical foundation for understanding how dialogue-based teaching approaches interact with student engagement patterns during pedagogical transitions.

The proposed framework enables researchers and educators to move beyond surface-level participation metrics toward understanding the cognitive depth of student engagement (Fredricks et al., 2004). By providing specific indicators and measurement approaches for each ICAP level within dialogic contexts, the framework supports evidence-based instructional design and assessment practices. This is particularly relevant for educational systems transitioning from traditional instruction to more interactive models, where understanding authentic engagement becomes essential for effective implementation.

This work contributes methodologically by establishing a theoretical foundation for measuring engagement quality in dialogic teaching contexts. The framework provides practical tools for educators to assess whether dialogic approaches achieve their intended cognitive outcomes, supporting more effective implementation of interactive pedagogies in technology-enhanced learning environments (Mercer & Dawes, 2014). Future applications could incorporate natural language processing algorithms to scale the analysis while maintaining the framework's emphasis on cognitive depth over superficial participation.

Keywords: student engagement evaluation; ICAP framework; dialogic teaching; educational assessment; engagement profiles

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A Novel Bayesian Knowledge Tracing Model for College Students in Language Learning

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Abstract: English reading skills are a cornerstone of academic communication, professional knowledge acquirement and career development in higher education (Göpferich & Neumann, 2016). With the growing need for personalized learning in language education, accurately monitoring students' knowledge acquisition has become crucial. Previous study have used linear mixed-effects model (Raudszus et al., 2021) and cognitive diagnosis models (Chen et al., 2025) to examine the reading comprehension growth in first language and second language readers. However, research on tracking the mastery of college students' reading subskills remains limited. To address this gap, this study proposes a Bayesian Knowledge Tracing (BKT) model specifically designed to monitor English reading skill development among college students. BKT, originally created to trace procedural knowledge mastery, updates the probability that a student has mastered a particular skill based on their learning performance over time. Although BKT has been widely used in STEM fields such as mathematics (Fisch et al., 2011) and programming education (Kantharaju et al., 2022), its application to language learning is relatively rare.

The dataset utilized in this study consists of response data collected from 303 undergraduate students at a university in Shanghai. The assessment consisted of sixty multiple-choice items. Each item was tagged with one reading subskill, including analyzing details, comprehending stated information, making inferences, interpreting information, understanding authors' attitudes, inferring vocabulary meanings, and summarizing main ideas. Area Under the Curve (AUC) metric was used to evaluate the performance of model.

The results demonstrate a reasonable ability to distinguish between students who mastered English reading skills and those who did not, with an AUC score of 0.692. Further analysis revealed a skewed distribution in the predicted mastery probabilities: while a significant proportion of students were predicted to have fully mastered certain skills (with probabilities clustered around 1.0), another subset showed only moderate mastery levels (with probabilities ranging between 0 and 0.4) across various skills. This research extends the application of BKT into the domain of language education, particularly in English reading comprehension, and highlights its potential to support data-driven educational technologies.

Keywords: Bayesian Knowledge Tracing, college student, English reading skills, language learning.

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AI 驅動的 STEAM 教育創新：融合 XR 技術的低收入家庭學生技能提升策略

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【摘要】為解決低收入家庭學生在教育資源不足與技能發展受限的結構性問題，本研究提出一套融合人工智慧（AI）推薦演算法與延展實境（XR）技術的混合式 STEAM 教育模式。系統採用模組化設計，核心為 AI 藝術創作模組，聚焦於創意思維與視覺表達能力的培養，結合 XR 沉浸式互動環境與個性化任務推薦機制。平台主要由三個功能模組構成：學習者登入與診斷分析系統、AI 驅動的學習任務推薦介面，以及支援沉浸式互動的 XR 模擬操作空間。學生可透過語音、視覺與點選操作與系統互動，完成包括任務選擇、AI 圖像生成、設計修改與作品提交等步驟；教師則可使用後台管理功能追蹤學習進度與評估指標，並依據系統建議進行教學調整。

研究於兩所大灣區中學進行為期 12 週的教學實驗，涵蓋 68 位年齡介於 12 至 15 歲、來自低社經背景的初中學生。實驗組使用本平台進行混合式學習，對照組則採傳統授課模式。本研究採用準實驗法，輔以量化統計與平台使用行為數據進行分析，包含三項評量指標：學習動機、技術素養與跨學科整合能力。

實驗結果顯示，實驗組在各項表現上均顯著優於對照組，學生任務完成度與創造性指數提升尤為明顯。平台互動資料亦反映個性化推薦與 XR 模擬場景能有效提升學生參與度、自主學習意願及技術應用能力。

本研究證實，融合 AI 推薦演算法與 XR 沉浸互動技術的混合式 STEAM 學習平臺，具備提升弱勢學生學習成效與教育公平的潛力，並可作為未來智慧學習環境設計的重要參考模式。
【關鍵詞】人工智慧教育應用; XR（虛擬與擴增實境）; STEAM 課程設計; 教育公平; 個性化學習

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UAV 编程教学促进儿童多元智能发展的研究

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【摘要】本研究以人工智能教育创新为核心理念，采用加德纳多元智能理论为框架，旨在探讨 UAV（无人机）图形化编程教学对小学低年级学生多元智能发展的影响。研究通过构建 UAV 编程教学课程，整合 Scratch 编程平台与“思创优学”无人机教学系统，构建了“算法设计-图形化编程-智能决策”三位一体的《模拟飞行》人工智能教育系列课程。课程采用创设情境→确定问题→协作学习→效果评价的流程，使学生在图形化编程中发展人工智能思维。

研究选取 3-4 年级的 16 名学生进行多次教学，并选取其中 6 次课程展开研究。采用量性研究与质性研究相结合的方式，量性研究方面，采用信效度达标的《多元智能自测量表》(Cronbach's α=0.956)进行对比分析；质性研究方面则通过课堂观察记录、文献研究及问卷调查进行。统计结果显示，学生在空间智能(t=5.94, p<0.05)、数理逻辑智能(t=6.87, p<0.05)和自然观察智能(t=5.06, p<0.05)三个维度呈现显著提升，其中对数理逻辑智能的影响最显著，表现为学生能准确解构编程程序，完成无人机模拟飞行过程的构建。

研究成果为人工智能时代下教学变革提供了实践范式，同时为教师开展无人机编程教学提供新路径，为教育工作者开发技术融合型课程、革新技术赋能的教学方式、建设基于多元智能发展的教学评价系统等具有重要参考价值，并为未来的人工智能教育改革提供了新思路。

【关键词】 UAV 编程；人工智能教育； 编程教学； 多元智能； 智能发展

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生成式课堂教学行为研究——基于滞后序列分析

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【摘要】随着生成式人工智能应用在课堂教学中，生成式课堂教学呈现出互动主体多、资源工具多样、教学互动行为复杂等特征。将生成式人工智能应用在课堂中，仍处于探索阶段，对生成式课堂进行教学行为分析，有助于教师了解课堂特征，促进教学反思并提升生成式课堂质量（黎加厚, 2024；朱永新 &杨帆, 2023）。因此，本研究以 2024 年广东省教育“双融双创”教师数字素养提升实践成果示范应用推广活动中的公开示范课例为研究样本，利用视频分析法和滞后序列分析法对生成式课堂教学行为进行分析，共得到 455 个行为样本，进一步分析该示范课的课堂师生的行为占比、行为序列以及生成式人工智能应用情况。研究发现，当前在教学方法、师生机互动、课堂管理节奏上均存在问题，在此基础上提出相应建议，以期能帮助教师们开展生成式课堂教学。

【关键词】 生成式课堂；课堂教学行为；滞后序列分析

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Influencing Factors of Artificial Intelligence Literacy among University Students: Based on an Extended UTAUT Model

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Abstract: In the era of Artificial Intelligence (AI), there is a huge shift in STEAM education for university students. Moreover, it is essential to enhance their digital resilience and AI literacy (Černý, 2024; Gomes et al., 2025). However, there is still a lack of research on the improvement of digital resilience and AI literacy for university students in the field of STEAM education. This study aims to unveil influential factors of development of AI literacy, to explore how digital resilience influences AI literacy based on the UTAUT model, and to provide implications of enhancement of AI literacy. In this study, the PLS-SEM method was used to reveal the factors influencing the use of Generative artificial intelligence (GenAI) in university students' AI literacy based on the UTAUT model and their interrelationship with the mediating variable digital resilience. A total of 369 valid data were collected and analyzed using SmartPLS 4 software. The study found that performance expectancy (PE), social influence (SI), and facilitating conditions (FC) all directly influence behavioral intention (BI) and AI literacy (AL), and they also indirectly affect behavioral intention (BI) through digital resilience (DR) and indirectly affect AI literacy (AL) through behavioral intention (BI). However, expectancy effort (EE) has no significant influence on digital resilience (DR), behavioral intention (BI), and AI literacy (AL). In summary, all factors can explain 72.1% of AI literacy. It is suggested that teachers cultivate students' habit of learning based on AI. Through data analysis tools and technologies, students can have real-time access to key learning resources, thereby better assessing their own learning performance and promptly adjusting strategies to meet performance expectations. Create an atmosphere within the school where AI is used for learning. Students can form study groups to use AI for learning together. At the school level, large-scale training sessions or activities can be held to build an environment that encourages the use of AI for learning. Schools should ideally provide convenient tools and platforms for learning with AI. For example, they can directly offer students specific AI recommendations for learning particular courses.
Keywords: Generative AI; Digital resilience; AI literacy; UTAUT; PLS-SEM

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AI 生成教学代理人的专业性、吸引力与性别对学习过程与效果的交互作用

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【摘要】在人工智能技术迅速发展的背景下，AI 生成教学代理人（AIPAs）被广泛应用于视频教学，旨在通过模拟教师的表情、动作和语音，实现认知与情感支持，进而促进学习。已有研究表明，AIPAs 在视频教学中的专业性与吸引力因其能够显著提升学生的学习参与度和学习效果而备受关注。大量文献也证实，AIPAs 的专业性、吸引力和性别水平显著影响学生对其可信度、注意力及学习成绩的感知。然而，尽管先前研究分别探讨了 AIPAs 这三方面的独立效应，但有关其在视频教学中对学生学习过程与结果的交互作用的研究仍相对有限。因此，本研究旨在探讨 AIPAs 的专业性、吸引力和性别对初中生在视频教学中注意力、认知负荷、学习体验及学习结果的综合影响。本研究采用 2（专业性：高 vs. 低）× 2（吸引力：高 vs. 低）× 2（性别：男性 vs. 女性）三因素组间实验设计，随机分配 226 名初一学生进入 8 种实验条件。实验持续 45 分钟左右，被试首先填写人口统计学信息，随后观看教学视频，期间实时记录眼动数据。通过眼动追踪技术，结合兴趣区划分，采集并分析注视时间比例、首次注视时间和注视次数等指标。实验结束后，依次完成保持和迁移测试、认知负荷及学习体验的测量问卷。研究结果显示，具有较高专业性与吸引力的 AIPAs 能显著提升学生的学习动机、与代理人的互动感知以及迁移成绩，且该作用不受性别影响。同时，男性 AIPAs 在专业性和吸引力均高的情况下会增加学生的内在认知负荷。值得注意的是，低专业性且低吸引力的男性 AIPAs 能引导学生更多关注教学视频，从而提高保持成绩；而低专业性的女性 AIPAs 则引发较高的相关认知负荷，可能促进学生的深层加工。研究表明，在视频教学中优化 AIPAs 的专业性与吸引力有助于提升学生的认知投入与知识迁移水平，从而提高学习效果。
【关键词】 AI 生成教学代理人；视频教学；眼动追踪技术；社会线索

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教师如何在教学中使用 AI？—基于 89 所世界一流大学人工智能政策文本的分析

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【摘要】生成式人工智能（GenAI）正加速渗透教育场景，引发了对于技术依赖造成的伦理失范、主体性危机及教学同质化等诸多风险的讨论。在人工智能时代，高校如何规范教师的教学行为，使得人工智能工具有效提升教学质量，成为各利益相关方的关切所在。与国外高校形成鲜明对比的是，中国鲜有高校发布系统性人工智能使用规定，制度规范普遍滞后于技术应用。学术界关于高校人工智能政策的研究，多关注高校对于教师和学生使用的立场，缺乏对于如何规范教师教学行为的微观分析；多关注部分国家或地区高校的规定，鲜有汇聚世界顶尖高校的比较研究。基于此，本研究采集 QS 世界大学排名前 200 名的高校政策文本，重点探讨世界一流大学人工智能政策对教师教学行为的规训。由于数据可得性的实际情况，研究者最终采集 89 所高校政策文本（例如，宾夕法尼亚大学的《Generative AI and Its Implications for Your Teaching》）。本研究综合运用福柯规训理论核心要素（空间分配术、规范化裁决、层级监视体系、检查技术及主体重构等），对高校政策文本开展系统的文本分析。结果显示，世界一流高校人工智能政策以赋能性、约束性和豁免性三类工具协同为核心价值导向，既重视规范与风险防控，也鼓励教学创新与能力提升。政策通过分阶段、分环节的具体行为指令，将不同价值导向落实到教师教学全过程，对教师在各教学环节的 AI 应用进行系统规制。同时，政策文本在 AI 素养建构方面强化了伦理与能力要求，但对以人为本和持续学习发展关注仍显不足。本研究建议高校结合实际情况制定弹性适切的政策工具，科学提升教师人工智能素养，构建人工智能教育治理体系。

【關鍵詞】 人工智能政策；世界一流大学；教师教学行为；人工智能素养

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Integrating STEAM and Maker Education through Design and Technology in Hong Kong Secondary Schools

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Abstract: In recent years, the rise of STEAM education has revitalized interest in Design and Technology (D&T) within Hong Kong's secondary education landscape. D&T is now evolving into a multidisciplinary platform that fosters creativity, problem-solving, and technological literacy. This transformation aligns with broader educational reforms and the global emphasis on 21st-century skills. D&T, as a subject rooted in making and problem-solving, serves as a natural medium for STEAM integration. Echoing Dieter Rams' notion that "good design is made for people," the reimagined curriculum emphasizes empathy, human-centric design, and the development of solutions through iterative prototyping and testing. This emphasizes the principles of the engineering design process, which requires students to define problems, generate ideas, build prototypes, and evaluate outcomes (National Research Council, 2012). The design process encourages critical thinking and promotes resilience through trial and error, making it an ideal foundation for STEAM learning.
STEAM education promotes an integrative and cross-curricular approach to teaching and learning. It encourages educators to embed knowledge and skills from multiple disciplines into cohesive projects. For instance, students apply scientific principles and mathematical reasoning to solve real-world problems through technological tools, while art fosters aesthetic judgment, cultural awareness, and creativity (Bequette & Bequette, 2012).
Two classroom-based projects carried out at my school for Secondary students illustrate the effectiveness of integrating iterative STEAM and maker education in the classroom. The first involves using programmable drones to simulate coral reef monitoring. In this activity, the classroom represents the ocean floor, with coral reef checkpoints placed around the space. Students are tasked with developing drone flight programs to visit each checkpoint efficiently. This process involves interdisciplinary skills: scientific understanding of ecosystems, programming logic and algorithms, engineering navigation systems, spatial mapping using mathematics, and collaborative planning. The project also highlights how simulated environments can develop students' environmental awareness and design thinking (Martinez & Stager, 2013). Practically, 2 to 4 students in a group were allowed to perform the drone test within 10 minutes. The drones are not powerful in terms of sensor and sometimes inaccurate in terms of distance travelled. Sometimes the drone failed to perform the programme block, for example, hovering on top of the checkpoint without moving to next checkpoint, they may stop the programme, measure the error, retrieve the drone, and edit the programme. Students were required to adjust the programme considering the practical scenario. For instance, adding a programme block to descend the drone to "see" more clearly instead of relocating the checkpoint as it represent coral reef in reality was observed in students' work.
The second project emphasizes technological capability, aesthetics, and entrepreneurship through the creation of a file of 3D wooden animal puzzles for prolonged usage. Reason of using laser cutting technology is discussed with students. Students begin by studying animal anatomy and behaviour, then design their own puzzle using a CAD software, Onshape, incorporating mathematical concepts such as symmetry and variables. Variables were well used in setting thickness of materials and joints of parts as thickness of material is subject to change. The process includes understanding material properties, digital fabrication, and iterative design. They further photograph their final product using compositional techniques (e.g., rule of thirds, perspective, depth of field), integrating visual literacy and promoting entrepreneurial thinking. This project not only enhances students' making skills but also demonstrates the potential for interdisciplinary application in both digital and artistic domains.

These examples reflect the core philosophy of maker education, which emphasizes learning through doing, creativity, and collaboration (Halverson & Sheridan, 2014). Maker education encourages student autonomy, they take ownership of their learning, engage with materials in meaningful ways, and connect abstract concepts to tangible outcomes. When integrated with the STEAM framework, maker education fosters an environment where students are empowered to explore, create, and innovate.

In conclusion, the transformation of Design and Technology in Hong Kong illustrates the potential of STEAM and maker education to enrich student learning. By integrating science, technology, engineering, art, and mathematics into cohesive, hands-on experiences, students develop not only technical competencies but also critical thinking, creativity, and empathy. These interdisciplinary approaches are crucial in nurturing future-ready learners equipped to solve complex problems in an ever-changing world.

Keywords: Technology education, Design and Technology, interdisciplinary learning, drone programming, Onshape

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Enhancing Academic Performance through the Integration of AIoT Education in Computer Literacy

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Abstract: The integration of Artificial Intelligence (AI) and the Internet of Things (IoT)—collectively termed AIoT—significantly reshapes educational methodologies, particularly in Computer Literacy. A leading expert in the application of AI in education proposed a framework for understanding the complexity of human intelligence by identifying the comparative limitation of AI when analysed using the same framework and offers clear-sighted recommendations for how educators can draw on what AI does best to nurture and expand our human capabilities (Luckin, 2017). While integrating artificial intelligence (AI) into education brings benefits to the education landscape, there are also significant risks. To fully utilize AI's technological innovation for educational purposes, ethical considerations must be taken into account (Micheni et al, 2024). The effectiveness of AI-driven educational tools and assess their implications for students, educators, and institutions have been analysed (Degni, 2024). However, the research did not mention the effect on students' academic performance of using AIoT education in the school curriculum. So, this study evaluated the effectiveness of AIoT education in the curriculum in terms of students' academic performance. It examined how AIoT enhances academic performance through personalized learning experiences, improved engagement, real-time feedback, and collaborative environments. By exploring theoretical frameworks, benefits, challenges, practical applications, and case studies, the research highlights the transformative potential of AIoT in education. As technology evolves, educational practices increasingly adapt to diverse learning styles and paces. AIoT integrates AI technologies with IoT devices, enabling the collection, analysis, and action of real-time data. This interconnectedness optimizes classroom management and fosters collaboration among students and educators.

Despite the documented advantages of AI in education, the specific impact of AIoT on academic performance remains underexplored. This study aims to bridge that gap by evaluating the effectiveness of AIoT education in enhancing students' proficiency in Computer Literacy. From January to May 2024, a tailored curriculum for S3 students, integrating hands-on activities and theoretical concepts, was implemented in collaboration with AIphotonics Limited. The effectiveness of this approach was evaluated through a data-driven analysis of academic performance improvements linked to AIoT education.

The S3 AIoT curriculum encompasses core topics, including AIoT concepts, basic electronics, assembly of a robotic arm kit, Arduino programming, and circuit design. Teachers utilized resources from AIphotonics Limited to facilitate learning, ensuring students acquire practical skills alongside theoretical knowledge. The curriculum is structured into three stages: introduction to theoretical concepts, instruction in text-based programming using Arduino, and practical applications where students design solutions to real-world problems using AIoT principles.

Top-performing students were selected for enhancement classes to apply their knowledge in competitive environments. These students have gained recognition in interschool competitions, showcasing innovative applications of AIoT education. A three-day training session prepared teachers to guide students through the curriculum, covering AIoT concepts and basic sensor functionalities.

The study involving five teachers and 112 S3 students employed engaging teaching strategies to compare academic performance between those receiving AIoT education and a control group (without AIoT education), revealing significant improvements in performance among AIoT students, with statistical tests confirming a positive correlation between AIoT education and enhanced performance metrics.

The significant differences in the lowest mark, first quartile, second quartile, and third quartile between S3 Computer Literacy marks of students with and without AIoT education further support the mean improvement in academic performance. The formal test for distributional differences is by using the Pearson correlation coefficient. The methodological details were the statistical method used. One way to quantify the relationship between two variables is to use the Pearson correlation coefficient, which is a measure of the linear association between two variables (Zach, 2020).

Students with AIoT education achieved significantly better academic performance and greater engagement in learning activities than their peers without it, demonstrating the positive impact of integrating AIoT into the Computer Literacy curriculum.

In conclusion, this study demonstrates the effectiveness of integrating AIoT education into the Computer Literacy curriculum, resulting in enhanced academic performance. The findings highlight the necessity for ongoing exploration of AIoT's role in education to enhance engagement and create a more practical learning experience.

Keywords: Artificial Intelligence, Internet of Things, AIoT education, Arduino, academic performance

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Advancing Virtual Reality Creation in Maker Education with Learning Analytics and Generative Artificial Intelligence

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Abstract: Virtual Reality (VR) has emerged as a transformative tool in education, offering immersive environments that simulate real-world scenarios and create entirely new worlds to enhance student engagement. However, in previous applications of VR in maker education, students often acted as consumers of VR contents rather than creators. To realize the potential of VR-based maker education, we developed a low tech-barrier pedagogy of VR content creation (Hu & Ng, in press). Built on this pedagogy, a web-based VR content creation platform was developed integrating learning analytics and Generative AI support (Wang et al., 2022). Over the past four years, more than 1,200 VR stories were created by over 1,000 students on the platform. Participants ranged from university students in general education courses to K–12 students in workshops, working on themes such as cultural heritage and environmental protection. By lowering the technical and financial barriers to VR creation, we empowered students of diverse backgrounds to participate in VR creation. Learning analytics (LA) enhances teaching and learning by automatically collecting, analyzing, and visualizing data about learners and their environments. Leveraging our in-house developed platform, which provides full access to student interaction data, comprehensive analyses of both system logs and student-generated artifacts can be conducted through LA methods. In response to student needs for personalized feedback, LA dashboards are developed and integrated directly into the platform, offering real-time insights into student progress and engagement. For K-12 students specifically, the platform is further enhanced by adding collaborative VR creation features, which enables the implementation of collaborative learning analytics to assess the quality of collaboration during students' maker activities (Wang et al., 2024). Through collaborative learning analytics, teachers and researchers can better understand and scaffold team dynamics and support collaborative skill development. The VR stories created by students are multimedia artifacts composed of images, text, background music, and audio narration. To analyze these creations, we adopted Multimodal Learning Analytics (MMLA), which integrates data from multiple sources and modalities. Machine learning techniques, such as Music Information Retrieval (MIR), have been employed to gain a comprehensive understanding of students' creative processes and learning outcomes. Our findings highlight that LA serves not only as an evaluation tool but also as a formative mechanism that can dynamically shape the learning environment in real time. Operating within multiple iterations of design-based research studies, insights derived from LA are instrumental in the iterative improvement of both the pedagogy and platform features. LA informs the refinement of pedagogical strategies, leading to better scaffolding of student reflection and self-regulatory processes. By integrating LA with VR creation, we are able to foster a more adaptive, personalized, and impactful learning experience, empowering students to take greater ownership of their learning journeys. Findings also demonstrate that integrating LA significantly improves students' achievement of learning outcomes arising from VR creation, for example, deeper understanding of content knowledge, information, and digital literacy skills, and effectively creating public-facing artefacts with real-world applications. With the emergence of Generative AI, AI tools have also been integrated into the platform to assist students in generating content. A range of AI-driven features have been incorporated on the VR creation platform to further support students' creative processes including customized chatbots, image and music generation tools. These tools not only provide students with powerful new creative resources but also foster deeper engagement with the technology itself. Looking ahead, we aim to explore the future convergence of learning analytics, artificial intelligence, and maker education to further enrich student learning process and outcomes in VR creation.
Keywords: Virtual reality, Maker education, Learning analytic

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基于 STEAM 理念的高中信息技术跨学科主题学习设计与实施——以“帮‘盲’红绿灯识别器”项目为例

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【摘要】在 AI 技术驱动教育变革的背景下，STEAM 教育如何通过跨学科整合与智能技术协同提升学生核心素养成为关键议题。针对高中信息技术课程长期存在的学科壁垒突出、创新实践薄弱等问题，本研究以 STEAM 理念为框架，基于建构主义学习理论、多元智能理论及李克东跨学科学习活动 5EX 模型，融入生成式人工智能，构建了高中信息技术跨学科主题学习框架。该框架以“前端分析——策略制定——活动实施”为设计思路，前端分析聚焦于学习者特征、教学内容与教学目标三个维度；策略制定阶段融合了情境体验、探究学习和团队协作等多元化教学策略；活动实施环节则设计了“情境导入→明晰问题→小组协作→调试优化→迁移应用”的五步教学流程。整个框架强调通过真实问题驱动，整合科学、技术、工程、艺术、数学（STEAM）等多学科知识，以项目式学习促进学生核心素养的发展。并结合 STEAM 理念设计“帮‘盲’红绿灯识别器”教学案例，通过实证研究检验框架的教学效果。研究招募 S 市 D 中学高一年级 4 班 49 名学生作为实验班开展 STEAM 跨学科主题学习实践，通过单组前后测实验检验框架的教学效果。数据收集采用团队合作能力、问题解决能力、创新能力三份量表（Cronbach’s Alpha 系数均＞0.8，KMO 值＞0.7）及课堂效果前后测问卷，结合 SPSS27.0 量化分析与课堂观察质性研究。结果表明：相较于传统课堂，STEAM 理念下的高中信息技术课堂使学生团队合作能力（t=-8.667，p＜0.001）、问题解决能力（t=-7.556，p＜0.001）、创新能力（t=-9.836，p＜0.001）显著提升，慧编程软件技能掌握度从实验前 10.2%精通率提升至 26.5%，89.4%的学生对跨学科主题学习持支持态度。研究表明，AI 技术与 STEAM 教育的深度整合，不仅可突破学科知识孤岛化困境，更能通过真实问题驱动的智能项目实践，促进学生计算思维与创造性问题解决能力的协同发展，为 AI 时代下的跨学科教育创新提供可操作性范式。

【关键词】STEAM 教育；跨学科主题学习；教学设计；高中信息技术

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基于 UbD 理论的 STEMA 跨学科课程设计与实施范式研究——以《以人工智能预测出行》为例

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【摘要】在基础教育课程新一轮改革中，强调以发展学生核心素养为导向，着力建设和完善基础教育课程体系。2022 年，教育部印发义务教育课程方案和课程标准（2022 年版）的通知，强调义务教育阶段突出跨学科知识的融合教学与学生核心素养的培育（教育部，2022）。2023，教育部颁布《基础教育课程教学改革深化行动方案》，强调中小学教育应以核心素养为导向的跨学科主题学习进行深化改革，推进教育数字化转型赋能教育发展，构建数智时代新型教学模式（教育部，2022）。在基础教育课程改革深化背景下，跨学科素养培育与教育数字化转型成为核心目标。STEAM 教育通过多学科知识的融合教学，激发学生的创新思维潜力与问题解决能力，提高学生核心素养（周子明 et al., 2021），然而传统课程教育仍面临着教学目标模糊、学生参与度不高、知识应用能力不足等问题。UbD 理论（Understanding by Design，追求理解的教学设计）所倡导的“逆向设计”教学为解决该问题提供了新思路。与传统教学先聚焦教学内容和方法不同，UbD 理论强调教师在教学活动开展前，先明确学生学习应达成的目标，以及能证明学生达成目标的证据，从学习结果出发逆向规划教学行为（赵萍 &郭泽琳，2022)。因此，本研究聚焦 STEAM 教育中传统课程设计目标模糊、知识整合不足等问题，引入 UbD 理论的“逆向设计”框架，构建具有可操作性的跨学科课程开发与实施范式。研究以“逆向设计”为逻辑起点，构建包含“目标设定-评价体系-项目设计-教学实施”四阶段的实施框架，同时以《人工智能预测出行》课程设计为例，开展教学实证研究。研究采用混合研究方法，通过对定量数据与定性数据进行分析，运用 SPSS26.0 进行独立样本 t 检验与内容分析。研究表明，该范式通过“目标逆向推导-情境化任务驱动-多元评价反馈”机制，有效提升学生跨学科素养与问题解决能力，为中小学 STEAM 教学提供可借鉴的教学实践。

【关键词】 UbD 理论；逆向设计；STEAM 教育；跨学科课程；范式研究

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《基于 STEAM 理念的课例设计与开发——以农业智能采摘机器人为例》

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【摘要】针对初中 STEAM 教育中学科割裂与课程设计碎片化的问题，本研究聚焦“农业智能采摘机器人”主题，探索基于 STEAM 理念的课例开发路径。本研究通过文献分析与理论建构，整合科学、技术、工程、艺术、数学五维学科知识，构建“问题链-任务群”课例框架，设计以“需求分析—原型规划—系统优化”为主线的结构化学习流程，通过模拟真实场景，结合图形化编程与人工智能等工具实现学科融合。本研究通过跨学科课例的开发，将抽象学科知识转化为可操作的实践任务，为初中 STEAM 课程开发提供理论框架与设计范式，推动技术教育与社会实践衔接，为落实核心素养导向的课程改革提供参考。
【关键词】STEAM 教育；课程设计与开发；农业智能采摘机器人；跨学科整合

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Development and Exemplification of A Hierarchical STEM Instructional Design Framework for Students with Intellectual Disabilities: The ACCESSM Model

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Abstract: STEM education has emerged as a novel educational approach, with early exposure to STEM concepts demonstrating significant correlation with students' subsequent pursuit of STEM careers (Tran, 2018). The acquisition of higher-order cognitive skills through STEM education—including critical thinking, problem-solving, and creativity—enables students to address complex societal challenges. Research also indicates that STEM education yields particular benefits for students with special educational needs (SEN), including reduced attrition rates, enhanced mathematical performance, and increased post-secondary enrollment (Plasman & Gottfried, 2016). Moreover, the Education Bureau's policy framework (2023) emphasizes vocational training in the development of SEN students in Hong Kong, which aligns strategically with the career-oriented outcomes of STEM education. Consequently, STEM education presents both a suitable and viable educational approach within Hong Kong's SEN educational context.

Nevertheless, implementation challenges persist. Studies indicate that mainstream educators in Hong Kong face difficulties in STEM implementation (Ko & Lai, 2020; Chiu et al., 2021), with these challenges being more pronounced in SEN schools. Primary obstacles include insufficient educational resources (Pujaningsih & Praptiningrum, 2021), staffing constraints (Angelides et al., 2006), and heterogeneous learning needs.

To address these barriers, particularly for students with Intellectual Disabilities (ID), this research developed the ACCESSM model, a hierarchical STEM Instructional Design Paradigm (Figure 1). The model's theoretical foundation draws from Self-Determination Theory (Ryan & Deci, 2017) and references established STEM frameworks from both mainstream and special education settings (Li & Li, 2019; So et al., 2022; Wood & Courtade, 2024).

The ACCESSM model comprises four foundational components: Adaptive Learning, Cognitive Scaffolding, Collaborative Inquiry, and Engineering Mindset. Grounded in the assessment of learners' prior knowledge, Adaptive Learning entails the tailored development of instructional materials, the construction of authentic, problem-based scenarios, and the promotion of problem-solving mindset for specific ID students. Cognitive Scaffolding involves deconstructing intended solutions and establishing knowledge foundations through visual aids and concrete exemplars. Collaborative Inquiry facilitates structured scientific investigation through complementary role assignment and enhanced teacher-student and peer interactions. Engineering Mindset focuses on developing persistence and systematic thinking skills. These core elements collectively form the foundational thread of an inclusive STEM curriculum for students with ID. Their implementation should follow a progressive and systematic approach and be supported by three strategic components: Systematic Instruction, Self-Determination, and Multiple Evaluation.

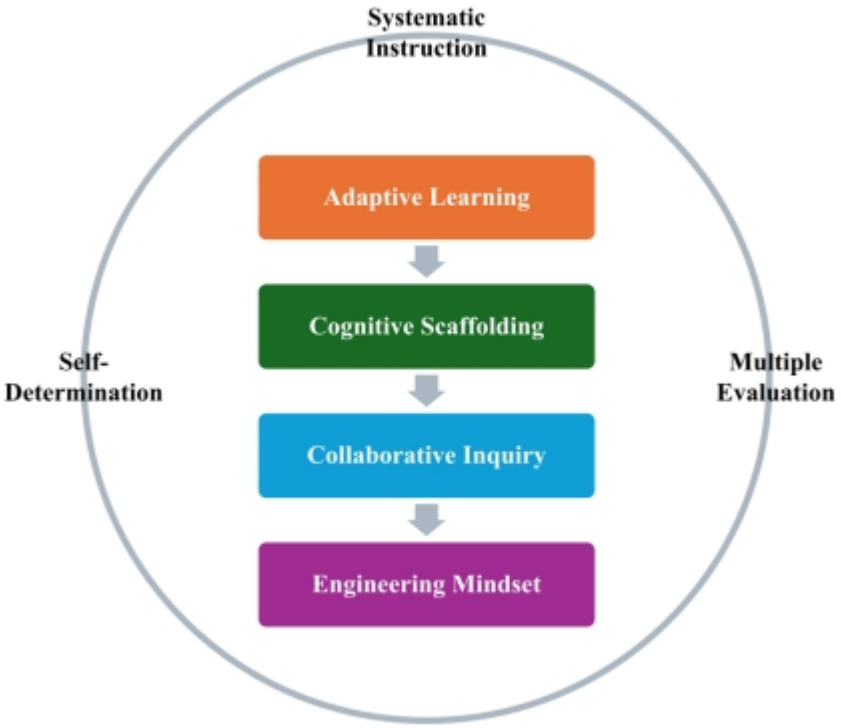

Figure 1 The ACCESSM Model

To respond to the heterogeneity among students with ID, the ACCESSM model incorporates three hierarchical competency levels—high, medium, and low. These levels correspond respectively to senior secondary students (Forms 4–6) with mild ID, junior secondary students (Forms 1–3) with mild ID, and senior secondary students with moderate ID. In alignment with this framework, the present research developed three sets of hierarchical STEM curriculum samples, each accompanied by comprehensive teaching packages, to demonstrate the practical application of the ACCESSM model. The selected topics—electronic vehicles, 3D modeling, and robotic grippers—can be naturally integrated into existing subjects such as General Studies, Science, Technology Education, Design and Applied Technology, or Information and Communication Technology within special education settings. Furthermore, these topics are designed to serve as a bridge to vocational education, thereby expanding future pathways for students with ID.

Overall, this research aims not only to enhance the inclusiveness of STEM education by fostering meaningful participation and future opportunities for students with ID, but also to empower both in-service and pre-service teachers. Through the ACCESSM model, educators are equipped to independently design effective STEM curricula, organize engaging learning activities, and tailor instruction to accommodate diverse learner needs.

Keywords: STEM Education, Adaptive Instruction, Special Educational Needs (SEN), Intellectual Disabilities, Self-Determination Theory

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XR（延展實境）與 AI 整合於遠距 STEAM 教育的智慧虛擬創客空間建構研究

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【摘要】隨著遠距學習日益普及，如何於虛擬環境中重現創客教育中強調的實踐　性與互動性，成為當前 STEAM 教育的重要挑戰。本研究聚焦於延展實境（XR） 與人工智慧（AI）的融合應用，建構智慧虛擬創客空間（Intelligent Virtual Maker　Spaces, IVMS）以提升學生在遠距學習中的沉浸體驗、創造力表現與學習動機。　所開發系統結合虛擬實境（VR）、擴增實境（AR）與 AI 即時教學回饋模組，學生可於沉浸式空間中進行 3D 建模、電路設計、程式開發等創客任務，並透過 AI 獲得個性化建議與錯誤修正提示，促進學習效率與創新思維培養。

系統整合多模態感知與學習歷程分析，能即時追蹤學生操作行為與反應時間，根 據表現動態調整教學策略。研究採用設計型研究方法進行三階段開發與驗證，邀 請 40 名 15 - 22 歲學生參與，分別於傳統線上課程與 IVMS 環境中完成同一創客專案，從創造力表現、合作解難能力與學習動機進行比較。

實驗結果顯示，使用 IVMS 系統的學生在創意測驗得分、任務持續時間與學習投 入程度上皆顯著優於對照組。系統內建 AI 學習分析數據指出，學生在接受即時反饋與具體引導下，學習挫折感明顯降低，並展現出更穩定的參與度與協作效率。

質性回饋亦反映學生普遍認為虛擬創客環境能有效模擬實體場景，促進跨學科技 能整合與創意思維激發，尤其在無法進入實體教室的情境下提供可行替代方案。

本研究首次提出結合 XR 與 AI 於遠距 STEAM 教育中創客空間建構的完整框架，驗證其在創新學習環境設計中的應用潛力與實證成效，對未來智慧教育場景設計具參考價值。未來將進一步拓展至多文化與多語言背景下的應用測試，並優化 AI 自主適應與群體協作模組，以實現更加普惠、具延展性之虛擬創客學習模式。

【關鍵詞】延展實境；人工智慧；虛擬創客空間；STEAM 教育；遠距學習

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生成式人工智能融合元认知策略的高中英语读后续写教学模式构建

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【摘要】在“双新”背景下的高中英语读后续写教学中，现有研究多聚焦于 AI 工具的语言形式纠错功能，但较少利用 AI 技术对写作叙事逻辑连贯性、情感曲线合理性等深层写作能力进行动态诊断与策略引导，且对学生元认知策略（如自我监控、策略调节）的智能赋能机制尚未形成体系化建构。

基于此，本研究基于元认知理论（Flavell, 1979），构建“GenAI+认知调节”融合教学模式：写作前，利用生成式人工智能（GenAI）深度解析学生历史文本的语言特征、叙事策略偏好及元认知水平，构建动态“学情画像”并定位“最近发展区”（Vygotsky, 1978），据此生成差异化支架（如为情节薄弱者提供“场景-动作-情感”模板）；写作中，通过双重辅助系统赋能元认知实践——学生获得语言优化工具支持，教师输入片段及元认知指令（如“检查情感逻辑”）触发 GenAI 生成情节图解、情感曲线分析等反馈，并推送提示（如“强化动作描写”）引导学生自主监控深层叙事要素；写作后，建立“语言-情节-情感”三维评估体系，由 GenAI 标注语言问题、检测情节断裂/跳跃、评估情感曲线突变，并针对性提供修改方案、连接模板及递进支架，同时基于个体错误分布推送分层训练任务，形成“诊断-干预-训练”闭环。本研究构建的“教师-GenAI-学生”协同机制，由教师设定技术干预边界、审核价值观导向、校准反馈建议并保留最终决策权，实现“技术赋能、人工校准”的智能教学范式。

本研究提出的体系化 GenAI 赋能元认知机制，精准对接“最近发展区”的个性化支架需求，突破传统反馈在叙事逻辑连贯性与情感曲线合理性等深层能力动态诊断上的瓶颈；同时通过确立以教师专业校准为核心的人机协同范式，为构建可持续的智能教育生态提供可复制框架，助力提升学生叙事构建、细节描写与情感逻辑的自主发展能力。

【关键词】生成式人工智能；元认知策略；高中英语；读后续写；教学模式

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AI 時尚：以自主學習為核心的 STEAM 教育創新實踐研究

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【摘要】本研究旨在探討如何將自主學習策略有效地融入融合生成式 AI (GENAI) 和資訊及通訊科技(ICT)的 STEAM 教育中，以提升學生的學習動機、協作能力和創新思維，並實踐跨代共融的服務學習目標。研究以「AI時裝設計計劃」為載體，設計了一系列包含 AI技術培訓、長者服飾需求研究、AI 輔助時裝設計和跨代時尚展演等環節的教學活動。研究對象為中四級學生，研究方法採用行動研究法，並輔以問卷調查，以收集學生在參與計劃前後的自主學習能力變化和學習體驗。

研究結果顯示，透過融入自主學習元素的教學設計，學生在預習習慣、協作學習能力和自主學習意識方面均有顯著提升。 具體而言，翻轉教室的預習模式培養了學生的自主探索能力， 協作學習活動（如專家組教學法和漸進式小組討論）促進了知識的深度交流和共享， 而服務學習的實踐則強化了學生的責任感和溝通技巧。 此外，學生對於 AI 技術的應用展現出高度的學習興趣和創新潛能，並體會到科技在促進跨代共融方面的積極作用。

研究也指出，在推行過程中仍需關注學生之間的能力差異、預習習慣的培養、教師的專業發展以及跨學科協作的統籌等挑戰。 總體而言，本研究驗證了自主學習策略在融合 AI 技術的 STEAM 教育中的有效性，為相關領域的教學實踐和研究提供了參考。

【關鍵詞】 自主學習；生成式 AI；STEAM 教育；跨代共融；服務學習

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基於深度學習的課堂疲勞檢測系統設計與應用

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【摘要】基於課堂教學中教師難以即時、全視角監測學生學習狀態的問題，以及線上學習中師生交流受限、學生容易產生學習疲勞等現象，本研究結合先進的電腦視覺技術和機器學習演算法，使用公開可用的面部表情資料集(C. Sagonas et al.,2016; C. Sagonas et al.,2013)，涵蓋身份、表情、照明條件、姿勢、遮擋和面部大小等變化，利用 OpenCV、Dlib 等工具開發了影像處理和特徵提取演算法，提出了一種基於深度學習的課堂疲勞檢測系統。實現疲勞檢測的過程涉及六個核心步驟：視頻採集、圖像預處理、人臉檢測及定位、特徵點提取、頭部姿態估計和疲勞判定。該系統能夠即時監測學生的面部特徵，特別是眼睛、嘴巴和頭部的動態變化，定義“正常狀態”和“疲勞狀態”，從而準確識別學生的學習疲勞狀態。此外，系統還引入了 3D 人臉模型匹配技術，以更精確地評估頭部姿態和表情變化，進一步提高疲勞檢測的準確性。在實際測試中，該系統對單人和多人都能進行疲勞測試，檢測準確率達到 93%，高於傳統的 PERCLOS 方法檢測準確率。在應用場景中，本研究首先聚焦於線下的課堂教學場景，不僅有助於教師精准把握學生的學習動態，還能促進教學方式的優化與授課品質的提升（張立軍等, 2024）。其次在線上教育場景下，能有效識別學生的線上學習狀態，教師可以初步評判教學效果，優化教學內容。最後在自主學習場景中，學生可以進行自我監控，科學安排學習與休息時間。總而言之，本研究不僅為教師和學生提供了一種有效的疲勞監測工具，還有助於教師及時調整教學策略，為學習者提供適切的教學服務，從而提高教學效率和學習效果，具有重要的理論意義和實際應用價值。

【關鍵詞】深度學習；課堂疲勞檢測；系統設計；應用研究

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基於 STEAM 框架下，幼兒創新素養發展實踐與探索——以“可攜式烘乾機”設計與建模為例

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【摘要】STEAM 跨學科強調以真實問題為導向，實現通過跨學科解決問題的的深度學習，從而培養學生的創新能力。然後，如何從真實的問題實現深度學習與創新能力的有效路徑成為了關鍵問題之一。

本文以“可攜式烘乾機”專案為例，以 STEAM 跨學科理論為依據，以發展跨學科知識與幼兒創新素養為目標，探索“激發動機—創意生成—計畫執行—反思迭代—成果創造”的教學有效路徑。本項目以解決“戶外晾乾衣服”的真實問題為始，以“創新便攜烘乾機”產品模型為終，“問題—假設—計畫—執行—反思—迭代”的迴圈發展路徑，實現幼兒創新素養的發展。同時，專案也兼顧了科學、技術、工程、藝術、數學等知識的學習。

實踐表明，這種從“真實問題”到“創新產品”的 STEAM 跨學科專案的實施，可以顯著激發了幼兒的深度探究動機與持續性學習投入，有效促進了多元學科知識的掌握和創新素養方面發展。本研究為幼稚園開展 STEAM 理念深度融合，培養幼兒跨學科知識與創新素養提供了實踐範例。

【關鍵詞】幼稚教育；STEAM 教育；跨學科融合；創新素養

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智能文本处理技术支持下的 STEAM 跨学科写作能力发展研究——以粤港澳中小学语文教学为例

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【摘要】在 AI 时代，STEAM 教育对学生跨学科写作能力提出更高要求，然而粤港澳中小学语文教学中，跨学科写作存在教学资源分散、个性化指导不足等问题。本研究基于智能文本处理技术，聚焦其在提升跨学科写作能力中的支持作用，探索有效路径。研究选取粤港澳地区 4 所中小学学生作为研究对象，涵盖小学高年级至初中阶段，学校类型包括公立学校、私立学校。本研究构建了以自然语言处理、生成式人工智能为技术支撑的"分析—诊断—干预—评估"教学支持系统架构。该系统通过智能文本分析精准定位学生写作薄弱环节，依据逻辑回归模型预测能力发展趋势，生成个性化学习报告。在此基础上，为教师提供基于数据可视化界面的差异化教学策略集，为学生定制包含智能写作辅助工具与分步训练模块的个性化学习路径。

本研究构建的智能文本处理技术应用模式，为粤港澳地区中小学 STEAM 跨学科写作教学提供了可复制的实践框架。该成果不仅验证了智能技术与语文教育深度融合的可行性，更为基础教育阶段跨学科教育改革提供了评价工具与可持续发展的技术路径，对推动教育信息化转型具有重要的学术与实践价值。

【關鍵詞】 智能文本处理技术；STEAM 教育；跨学科写作能力；中小学语文教学；粤港澳地区

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整合人工智能的教师跨学科教学设计能力模型构建与验证

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【摘要】随着人工智能等新兴技术的迅猛发展，教育领域正经历深刻变革，利用人工智能技术提升教师跨学科教学设计能力，已成为建设新时代高素质专业化教师队伍的关键抓手。当前教师基于人工智能开展跨学科教学设计时，仍面临能力内涵界定模糊、评价体系尚未健全(董艳, 陈辉&于浩, 2025)等问题，这阻碍了智能技术与跨学科教学的深度融合。基于此，本研究通过文献研究法、德尔菲法、层次分析法、问卷调查法系统探讨了整合人工智能的教师跨学科教学设计能力的理论内涵、结构模型及其有效性。

本研究立足数智时代下的教师跨学科教学能力发展需求，为教师跨学科教学设计能力开发了科学规范的评估工具。首先，通过文献分析和深入访谈，探索培养教师跨学科教学设计能力指标的组成结构与价值意涵，利用探索性因子分析和主成分分析法提取跨学科教学设计能力要素；接着，采用德尔菲法选取共 16 名教育技术专家与一线教师进行二轮意见征询，并通过层次分析法确定能力框架的权重指标，提取了整合人工智能的跨学科教学分析、跨学科过程设计能力与跨学科评价设计能力三个一级指标以及十二个二级指标模型；然后，选取某市人工智能教育普及示范区 200 位教师展开问卷调查，模型采用 Cronbach's alpha 系数检验信度，结果为 0.963，模型效度采用平均提取方差值 AVE 和组合信度 CR 进行检验，结果均表明各题项内部一致性较好，能够有效测量教师整合人工智能开展跨学科教学设计的能力水平。研究成果呼应了智能时代下教育主体应对复杂情境的创造性应答能力(赵婷&傅敏, 2025)、构建教师跨学科素养测评常模、探寻人工智能助力教师跨学科素养提升的可行策略的需求，为持续深化中国特色的教师跨学科素养测评理论与实践体系研究提供了宝贵借鉴。

【关键词】 跨学科教学设计能力；人工智能；能力框架构建；德尔菲法；层次分析法

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叩问工业技术文化与德国 STEM 教师教育培养之“道”——以巴伐利亚州“MINT-Plus 精英教师提升”项目为例

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【摘要】工业技术文化围绕技术与机器、企业与生产而形成，植根于“技术理性”，对于德国自然科学、技术教育的诞生与发展产生了极为重要的影响，也在很大的程度上影响了德国 MINT 教师（Mathematik 数学、Informatik 信息科学、 Naturwissenschaften 自然科学、Technik 技术，即 STEM）的专业化培养。为全面剖析德国 MINT 教师教育的基本特征，本研究将巴伐利亚州维尔茨堡大学、罗伊特大学联合开展的“MINT—Plus 精英教师提升”项目作为主要研究对象，采用文本分析与案例研究混合研究方法，系统分析德国 STEM 教师教育课程体系的主要特征，研究发现：其课程目标凸显“跨学科+科学研究”培养特色，课程内容聚焦跨学科主题学习内容，课程实施强调项目式教学与教学实践反思，彰显教师专业化发展的实践导向，多主体协同参与机制有效保障了 STEM 教师的培养质量。本研究重点探究德国 STEM 教师教育课程体系的重要特征，以期为我国科学教师专业化培养提供了一些有益的参考与借鉴。
【关键词】工业技术文化；德国；STEM 教育；MINT-PLUS 精英教师提升项目; 跨学科

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跨学科主题学习下中小学教师知识结构转型研究——基于国内外核心期刊的系统性文献综述

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【摘要】随着核心素养导向下教育改革的深入推进，跨学科主题学习已经成为了推动育人方式变革的关键抓手。跨学科主题学习作为一种新兴的教学模式，近年来受到广泛关注。它旨在打破传统学科界限，通过整合多学科知识，培养学生的核心素养和综合能力（宁依敏等，2024）。然而，面对“跨学科”带来的挑战，传统的教师知识结构逐渐呈现出单一化、理论化、静态化等特点，难以适应跨学科向多元化、实践化和动态化转型的需求。为探索跨学科主题学习下中小学教师知识结构应如何转型，本研究采用系统性文献综述研究法，选择中国知网和 Web of Science 两个数据库，对 2020 年至 2025 年的国内外核心期刊关于跨学科背景下教师知识相关的 58 文献进行系统分析。研究发现，教师跨学科知识结构面临三重维度的转型，内容知识转向多学科、融合型、生活类与研究型；教学知识指向目标、对象、情境、策略与评价的综合化；技术知识凸显开发类、操作类、应用类与整合类的特性。由此，中小学教师应以开放的心态应对跨学科背景下对教师知识结构提出的新要求，须践行内容知识导向从分科静态走向融合动态、教学知识导向从学科逻辑主导走向问题解决驱动、技术知识导向从单一的工具使用走向整合性技术赋能三大原则，以释放教师创新动能，从而促进基础教育阶段的创新型人才培养。

【关键词】跨学科主题学习；教师知识结构；教师专业发展；系统性文献综述

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推廣人工智能素養研究：以一所高小創新科技堂運用 AlphAI 培育人工智能為例

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【摘要】本研究探討香港一所小學於高年級創新科技課程中，運用 AlphAI 機器人推廣人工智能（AI）素養的教學成效。研究結合「做中學」理念與計算思維框架，採用混合研究方法，包括單組前後測設計（N=120）、課堂觀察及學生反思日誌分析，探討人工神經網絡（ANN）與監督式學習的教學實踐。研究發現，具象化操作介面能有效降低機器學習的抽象障礙，學生在「AI 模型訓練流程」的後測正確率顯著提升至 89%（前測 42%，p<0.001，效應量 d=1.35），其中低成就組進步尤為明顯。跨學科整合（數學邏輯與編程概念）不僅提升學生的算法設計能力，亦促進計算思維的遷移應用。

質性數據顯示，83%學生能準確區分「標籤」與「特徵」的差異，並將 AI 概念應用於實際問題解決（如設計自動導覽車）。此外，研究提出適合小學生的「AI 學習四階段模型」：感知→模擬→調參→遷移，並驗證「三層次認知支架」（具體操作→圖像表徵→符號抽象）的教學有效性。課堂觀察發現，學生透過 AlphAI 的可視化介面（如誤差曲線、神經網絡模擬）深化理解，低成就組在實作任務的參與度提升 42%。

研究揭示差異化學習成效：高能力學生展現元認知遷移能力（後測準確率 92%），而低能力學生在結構化指引下表現顯著改善（同儕合作提升 35%）。性別差異方面，女生更關注 AI 倫理議題（如數據隱私），男生則傾向優化模型性能。教師專業成長方面，參與教師能將 AI 概念連結至跨學科教學（如以「激勵函數」比喻考試壓力）。

然而，研究面臨資源限制（如設備成本）與課程時間不足等挑戰。建議未來結合生成式 AI 工具（如簡易 ChatGPT 模組）擴展教學，並發展「評估—教學—支援」三位一體的實施框架，以強化 AI 素養教育的可持續性。本研究為基礎教育階段的人工智能教學提供實證案例，證實具象化工具與跨學科設計能有效培養學生的 AI 素養，同時倡議政策層面支援資源分配與教師培訓。

【關鍵詞】人工智能素養；計算思維；監督式學習；AlphAI 機器人；STEAM 教育

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多智能体协同的初中生创造性思维培养平台设计与开发

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【摘要】在创新人才培养与“双减”政策深化背景下，初中教育日益重视创造性思维培养。生成式人工智能虽具备培养潜力，但当前教育应用多局限于学习者与单智能体的预设对话模式，难以适配创造性思维所需的差异化、流程化动态需求。针对此局限，《中小学生成式人工智能使指南（2025 年版）》提出构建多智能体协同机制。多智能体系统（MAS）作为分布式人工智能的新兴方向，可通过自治智能体协同解决复杂任务，为创造性思维培养提供新技术路径。因此，本研究拟开发基于 MAS 的平台原型，为初中生提供贯穿全程的结构化按需支持。基于双钻石模型“发现（发散）→定义（聚焦）→开发（发散）→交付（聚焦）”的四阶段设计流程，与吉尔福德关于创造性思维的 "发散-聚合思维" 理论形成了深度的理念契合。本研究以此为创造性思维培养框架，面向某初中校本课程的定向越野关卡设计任务，构建多智能体协同平台。依托 Coze 平台实现两大突破：角色化智能体分工（创意激发者：辅助产生创意灵感，逻辑分析师：评估方案可行性，实践构建师：提供关卡实现的技术建议，模拟测试者：模拟用户给予体验反馈）与动态调度机制（Coze 工作流引擎调度器实时解析学生设计阶段、交互行为及操作意图，按“主响应-补充-接力”范式动态调用智能体组合），实现全流程结构化支持。该平台聚焦初中生创造性思维发展需求，通过双钻石四阶段框架提供阶梯式训练，破解创意实践无序性问题；依托多智能体按需调度精准匹配各阶段认知负荷（如发散期降焦虑、聚焦期提效能），实现轻量化创新体验；基于 Coze 低代码特性构建校本课程友好型工具，为资源受限中学提供快速部署方案。未来将深化智能体对青少年认知特征的适应性，拓展至 STEM 融合场景，并通过实证验证长效育人价值。

【关键词】双钻石模型；多智能体协同；初中生；创造性思维

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人工智能技术支持下跨学科学习分析与评估的机遇、挑战与应对

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【摘要】新課標提出，課程標準需要設立跨學科主題學習活動，加强學科間相互關聯，帶動課程綜合化實施，强化實踐性要求，同時，强調推進信息技術與各學科的深度融合。跨學科學習自出現以來，國內外相關研究對其暫未有統一的概念界定，但對跨學科學習的學科融合性、情景真實性、合作實踐性等特性達成基本 共識，從其基本特性可見，該學習方式能夠培養學生的創新創造能力、團隊合作能力、問題解決能力等。但是，對於技術賦能跨學科學習分析與評估的過程中產生的問題，并未有深入且系統化的相關理論與實踐研究。因此，本研究將基於信息時代下，運用文獻研究法與案例研究法，結合研究現狀探討人工智能技術支持下的跨學科學習分析與評估所面臨的機遇、挑戰與應對，提煉出當下人工智能技術賦能跨學科學習分析與評估面臨的三大主要挑戰：評價標準難以界定、過程性數據難以收集、評價內容分析較爲淺層，並提出應對措施：首先，從知識結構、活動導向及跨學科教師合作三方面出發，提出變革知識結構、制定現實問題導向的跨學科學習活動等措施，以制定具有針對性和專業性的跨學科學習分析與評估標準；其次，針對現有技術無法收集並分析學生進行跨學科學習過程中的非結構性數據與思維活動數據等深層性數據問題，本研究建議引入多模態學習分析技術，將其應用於跨學科學習過程中，以實現全過程淺層性與深層性數據的收集和分析。

【關鍵詞】跨學科；跨學科學習與評估；人工智能技術

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