



香港教育大學
The Education University
of Hong Kong

大學正名十周年
The 10th Anniversary of
the University's Retitling

ICLT 2026

International Conference on Learning and Teaching

Transforming Teacher Education and Teaching:
Embracing Change and Innovation

21 - 23 April 2026

Conference Proceedings

ISSN: 3104-4980



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The Education University of Hong Kong

Celebrating the 10th Anniversary of EdUHK's Retitling

ICLT 2026

International Conference on Learning and Teaching

Transforming Teacher Education and Teaching:
Embracing Change and Innovation

Conference Proceedings

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1. Message from the President and Honorary Conference Chair



Professor LEE Chi Kin John, JP

President,
Director, Academy for Applied Policy Studies and Education Futures, Director, Academy for Educational Development and Innovation, Chair Professor of Curriculum and Instruction, The Education University of Hong Kong

Welcome to the 10th International Conference on Learning and Teaching (ICLT 2026).

The theme of this year's conference, "Transforming Teacher Education and Teaching: Embracing Change and Innovation," arrives at a historic juncture. The year 2026 marks the 10th Anniversary of The Education University of Hong Kong's (EdUHK) Retitling — a landmark milestone in our journey. As a young and vibrant university, we remain steadfast in our commitment to nurturing exceptional educators and diverse talent, driving social progress, and solidifying Hong Kong's position as a premier international education hub.

As the only university in Hong Kong SAR specifically dedicated to teacher education, our heritage spans over a century, tracing back to 1881. Shaping the future of education is not merely our obligation; it is a profound honour and a cherished mission. As the leading provider of future educators and social leaders, we remain unwavering in our commitment to advancing the standards of pedagogy to meet the complex, shifting needs of a global society. This commitment to excellence is reflected in our recent achievement in the QS World University Rankings by Subject 2026, where EdUHK is proud to rank 7th worldwide and 2nd in Asia for Education.

At EdUHK, we are passionately committed to bridging disciplines and cultures through impactful research and strategic partnerships. Hosting ICLT 2026 aligns perfectly with our vision to lead the discourse in teacher education. We are proud to provide a platform for this prestigious conference, continuing its tradition of uniting experts from diverse fields such as quality assurance, educational technology, and artificial intelligence. Today, we gather as a global community of educators, researchers, and visionaries. Your presence highlights our collective dedication to transforming the educational landscape—a task that is increasingly vital as we address societal challenges through emerging methodologies and technologies.

2026 is the Year of the Horse. Symbolising action, speed, and breakthrough, the Horse perfectly mirrors our current momentum. Mirroring this sign's representation of a spirited leap forward, EdUHK is embracing a period of rapid evolution and bold innovation. I would like to express my heartfelt gratitude to our keynote speakers and participants for their unwavering support. I wish you all fruitful discussions and an inspiring conference experience.

Thank you very much.

2. Message from the Vice President (Academic) and Conference Chairperson



Professor CHENG May Hung May

Vice President (Academic),
Executive Co-Director, Academy for Applied Policy Studies
and Education Futures,
Chair Professor of Teacher Education,
The Education University of Hong Kong

Thank you all for joining the International Conference on Learning and Teaching 2026.

At EdUHK, we are committed to promoting and supporting the strategic development of teaching, teacher education, and complementary disciplines. We achieve this by nurturing outstanding and morally responsible educators and professionals dedicated to lifelong learning. Our goal is to equip students across all levels, from undergraduate to doctoral programmes—with comprehensive knowledge and broadened horizons, aiming for graduates who are skilled professionals with a profound understanding of education, compassionate attitudes, and global perspectives.

The theme of this year's conference, "Transforming Teacher Education and Teaching: Embracing Change and Innovation," provides an opportunity for scholars to reflect on lessons learned and explore the way forward. The conference focuses on: (1) Teacher Education and Teaching; (2) AI, Metaverse, and STEAM Education; (3) Virtual and Blended Teaching and Learning; (4) Digital Humanities Education; (5) Quality Assurance in Higher Education and Training; and (6) other topics related to learning, teaching, and assessment.

This year, we are pleased to have received over 130 submissions, representing a wide spectrum of expertise—from teacher education and quality assurance to early childhood and higher education. I eagerly anticipate the presentations, the sharing of visionary ideas, and the deep insights that will undoubtedly emerge. We are particularly honoured to welcome our renowned keynote speakers and distinguished panellists, whose expertise across various facets of education will guide our discussions. It is my sincere hope that the connections made here will inspire meaningful collaborations in the near future.

My heartfelt gratitude goes to the Organising Committee, led by the Centre for Learning, Teaching and Technology (LTTC), in collaboration with the Faculty of Education and Human Development (FEHD), the Faculty of Humanities (FHM), the Faculty of Liberal Arts and Social Sciences (FLASS), and the Graduate School (GS), for making ICLT 2026 a success. Finally, I would like to express my appreciation to the guests, colleagues, and students supporting ICLT 2026.

I hope you find the conference fruitful and inspiring. Thank you.

3. Message from the Conference Organisers

The 10th International Conference on Learning and Teaching 2026 (ICLT 2026), organised by The Education University of Hong Kong (EdUHK), will be held in person from 21 to 23 April 2026. The Conference takes place at a significant moment for the education sector, as rapid technological advancements continue to drive fundamental changes. The Conference comprises keynote speeches by internationally renowned scholars, panel discussions, and paper presentations. It provides an interactive platform for academics, researchers, practitioners and professionals in the education sector to share innovative approaches to learning and teaching in higher education and to exchange good practices in school education.

In celebration of the 10th anniversary of EdUHK's retitling, the 10th ICLT 2026 will feature 13 keynote speeches, two panel discussions, and 21 paper presentation sessions. Under the conference theme, "Transforming Teacher Education and Teaching: Embracing Change and Innovation", scholars will gather to reflect on lessons learned and explore paths forward. The programme centres on six key strands, drawing a strong and engaged group of participants.

- Teacher Education and Teaching
- AI, Metaverse and STEAM Education
- Virtual and Blended Teaching and Learning
- Digital Humanities
- Quality Assurance in Higher Education and Training
- Other Topics Related to Learning, Teaching and Assessment

This year we have the privilege of welcoming speakers and participants participating in the conference in person. We have invited 13 renowned experts as keynote speakers. They are:

- Professor CHEN Wenli, Associate Dean (Office for Research) of National Institute of Education, Nanyang Technological University, Singapore
- Professor CHEN Xiangming, Professor of Graduate School of Education, Peking University, Beijing, China
- Professor CHENG May Hung May, Vice President (Academic), Chair Professor of Teacher Education, Executive Co-Director of Academy for Applied Policy Studies and Education Futures, The Education University of Hong Kong, Hong Kong
- Professor Christopher W. DAY, Professor of Education, Faculty of Social Sciences, Member of Centre for Research on Educational Leadership and Management (CRELM), University of Nottingham, UK
- Professor John FURLONG, Emeritus Professor of Education, University of Oxford, UK
- Professor Kelly FREEBODY, Head of Sydney School of Education and Social Work, The University of Sydney, Australia
- Professor Dragan GASEVIC, Professor of Learning Analytics, Faculty of Information Technology, Monash University, Australia
- Professor Angela Yung Chi HOU, Professor of College of Education, Chengchi University, Taiwan
- Professor LEE Chi Kin John, JP, President, Chair Professor of Curriculum and Instruction, Director of Academy for Applied Policy Studies and Education Futures, Director of

Academy for Educational Development and Innovation, The Education University of Hong Kong, Hong Kong

- Professor Kathleen PITHOUSE-MORGAN, Professor of Education, University of Nottingham, UK; Honorary Professor, University of KwaZulu-Natal, South Africa; Co-Editor of Teaching and Teacher Education; Co-Convenor of Centre for International Education Research, School of Education, University of Nottingham, UK
- Professor Miriam POSNER, Associate Professor of Information Studies and Digital Humanities, University of California, US
- Professor SONG Huan, Professor of Center for Teacher Education Research, Associate Dean of Faculty of Education, Beijing Normal University, Beijing, China
- Professor ZHANG Minxuan, Professor and Former President of Shanghai Normal University; Director of Teacher Education Centre under the Auspices of UNESCO, Shanghai, China

Additionally, we have invited 10 renowned experts as panelists for two panel discussions. They are:

AI-Driven Transformation: Reclaiming Educator Agency in the Digital Landscape

- Professor Kate REYNOLDS, Professor of Educational Psychology and Learning, Faculty of Education, The University of Melbourne, Australia
- Dr. Hardimah Mohd SAID, Dean of Sultan Hassanah Bolkuah Institute of Education, Universiti Brunei Darussalam, Brunei
- Professor YANG Xin, Professor of Northwest Normal University, Chinese Mainland
- Professor YIN Hongbiao, Chairperson and Professor of Department of Curriculum and Instruction; Director of Hong Kong Institute of Educational Research, The Chinese University of Hong Kong, Hong Kong
- Professor ZHANG Qian, Professor of Capital Normal University, Chinese Mainland

Navigating the Shift: Rethinking Educators for the Innovation Era

駕馭轉型——重塑創新時代的教育者角色

- Professor FENG Jianjun, Dean, College of Teacher Education, Nanjing Normal University; Director, Key Research Base of Humanities and Social Sciences of MOE, Institute of Moral Education, Nanjing Normal University
- Professor LI Shengbing, Dean, School of Education, South China Normal University; Executive Director, International and Regional Studies Center of MOE, Center for Hong Kong and Macao Studies, South China Normal University
- Professor ZHAO Ying, Dean, School of Education, Shanxi Normal University
- Dr. QIU Defeng, Associate Professor, School of Teacher Education, Southwest University
- Dr. SUN Caixia, Head, Department of Early Childhood Education, College of Teacher Education, Huzhou University

ICLT 2026 calls for papers from scholars around the world. This year, the Conference received 129 submissions by 231 authors from Chinese Mainland, Hong Kong, Viet Nam, Taiwan, Thailand, Australia, Russia, France, Israel, South Africa, Malaysia, Philippines, Singapore, Germany, United Arab Emirates, and United Kingdom. Table 1 shows the statistics of regions of the authors.

Table 1. Statistics of regions of ICLT 2026 authors

Regions/Countries	No. of Authors	Regions/Countries	No. of Authors
Hong Kong	133	Israel	3
Chinese Mainland	37	South Africa	3
Viet Nam	18	Malaysia	2
Taiwan	11	Philippines	2
Russia	6	Germany	1
Thailand	5	Singapore	1
Australia	4	United Arab Emirates	1
France	3	United Kingdom	1
		Total	231

Each submission underwent a thorough review process, with a minimum of three programme committee members assigned to review each paper during the first round. The results of these reviews were then subjected to meta-review by the chairs/coordinators of the corresponding strand. Following this rigorous evaluation, a total of 107 papers were accepted for presentation at ICLT 2026 (please refer to Table 2).

Table 2. Statistics of paper acceptance of each strand in ICLT 2026

Strand	Submissions	Accepted	Acceptance Rate
Teacher Education and Teaching	32	29	91%
AI, Metaverse and STEAM Education	45	32	71%
Virtual and Blended Teaching and Learning	12	10	83%
Digital Humanities	6	5	83%
Quality Assurance in Higher Education and Training	5	5	100%
Other Topics Related to Learning, Teaching and Assessment	29	26	90%
Total	129	107	83%

We would like to extend our heartfelt appreciation to the dedicated and hardworking strand coordinators, namely Professor GU Mingyue Michelle, Professor KONG Siu Cheung, Professor SONG Yanjie, Professor ERNI John Nguyet, Professor YEUNG Siu Sze Susanna, and Dr CHENG Kwok Shing Gary. They played a vital role in coordinating the review process for the 129 abstracts and full papers submitted to ICLT 2026. Their meticulous efforts ensured a fair and comprehensive assessment of the submissions. Our gratitude also extends to the programme committee members who diligently reviewed and provided valuable comments on the submitted papers. Their expertise and insights significantly contributed to the selection of high-quality papers for presentation at the Conference.

The success of ICLT 2026 would not be possible without the collective contributions of the strand coordinators and programme committee members. We appreciate their commitment to maintaining the highest standards of academic excellence in the review process. Our heartfelt gratitude goes to the organising committee, composed of colleagues from the Centre for Learning, Teaching and Technology, the Faculty of Education and Human Development, the Faculty of Humanities, the Faculty of Liberal Arts and Social Sciences, and the Graduate School, whose dedication will make ICLT 2026 a great success.

We will continue to organise the “International Conference on Learning and Teaching 2027 (ICLT 2027)” and more new strands will be included. We sincerely hope that our Conference will bring inspiration and a magnificent experience to all the participants. We look forward to meeting you again next year.

Thank you very much.

Dr CHENG Kwok Shing Gary
Programme Committee Chairperson

Professor XU Guandong
Conference Co-Chairperson

Professor CHENG May Hung May
Conference Chairperson
International Conference on Learning and Teaching 2026

4. Organising Committee

Honorary Conference Chair



Professor LEE Chi Kin John, JP

President,
Director, Academy for Applied Policy Studies and Education
Futures,
Director, Academy for Educational Development and Innovation,
Chair Professor of Curriculum and Instruction,
The Education University of Hong Kong

Chairperson



Professor CHENG May Hung May

Vice President (Academic),
Executive Co-Director, Academy for Applied Policy Studies and
Education Futures,
Chair Professor of Teacher Education,
The Education University of Hong Kong

Co-Chairperson



Professor XU Guandong

Assistant Vice President (Artificial Intelligence and Education
Innovation),
Director of University Research Facility of Data Science and
Artificial Intelligence,
Chair Professor of Artificial Intelligence,
The Education University of Hong Kong

Programme Committee Chair



Dr CHENG Kwok Shing Gary

Director, Centre for Learning, Teaching and Technology,
Associate Co-Director, Global Institute for Emerging Technologies,
Executive Co-Director, AI, Brain, and Child Research Centre,
Associate Professor, Department of Mathematics and Information
Technology,
The Education University of Hong Kong

Programme Committee Co-Chairs



Professor Bruce MACFARLANE

Dean of Faculty of Education and Human Development,
Chair Professor of Educational Leadership,
The Education University of Hong Kong



Professor LEUNG Pui Wan Pamela

Acting Dean and Associate Dean (Quality Assurance and
Enhancement) of Faculty of Humanities,
Executive Co-Director of Academy for Educational Development and
Innovation,
Professor (Practice) of Department of Chinese Language Studies
The Education University of Hong Kong



Professor LI Wai Keung

Dean of Faculty of Liberal Arts and Social Sciences,
Research Chair Professor of Data Science,
The Education University of Hong Kong



Professor CHEN Junjun

Dean of Graduate School,
Professor of Department of Education Policy and Leadership,
The Education University of Hong Kong



Dr CHENG Po Ying Sidney

Librarian,
The Education University of Hong Kong



Mr WONG Ho Kit Roger

Chief Information Officer of Office of the Chief Information Officer,
The Education University of Hong Kong

Strand Coordinators

Teacher Education and Teaching



Professor GU Ming Yue Michelle

Assistant Vice President (Research), Professor, Department of English Language Education,
The Education University of Hong Kong

AI, Metaverse and STEAM Education



Professor KONG Siu Cheung

Director of Artificial Intelligence and Digital Competency Education Centre, Research Chair Professor of E-Learning and Digital Competency,
The Education University of Hong Kong

Virtual and Blended Teaching and Learning



Professor SONG Yanjie

Associate Co-Director of Academy for Applied Policy Studies and Education Futures, Associate Director of Centre for Excellence in Learning and Teaching, Professor of Department of Mathematics and Information Technology,
The Education University of Hong Kong

Digital Humanities



Professor ERNI John Nguyet

Co-Director, Research Centre for Creative Arts and Public Value, Chair Professor of Cultural Studies,
The Education University of Hong Kong

Quality Assurance in Higher Education and Training



Professor YEUNG Siu Sze Susanna

Associate Vice President (Quality Assurance), Executive Co-Director of Academy for Educational Development and Innovation, Professor of Department of Psychology,
The Education University of Hong Kong

Other Topics Related to Learning, Teaching and Assessment



Dr CHENG Kwok Shing Gary

Director, Centre for Learning, Teaching and Technology, Associate Co-Director, Global Institute for Emerging Technologies, Executive Co-Director, AI, Brain, and Child Research Centre, Associate Professor, Department of Mathematics and Information Technology,
The Education University of Hong Kong

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LIAN Yi Ripple, Graduate School, The Education University of Hong Kong

CAO Anran Nason, Graduate School, The Education University of Hong Kong

YUNG Anniella Ignazia, Graduate School, The Education University of Hong Kong

CHUNG Wai Yin Koey, Centre for Learning, Teaching and Technology, EdUHK

CHEUNG Bridget, Centre for Learning, Teaching and Technology, EdUHK

YAU Shuk Yi Shirley, Centre for Learning, Teaching and Technology, EdUHK

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LUO Zijian Lumen, Centre for Learning, Teaching and Technology, EdUHK

CAO Jiaxin Galaxy, Centre for Learning, Teaching and Technology, EdUHK

CHEUNG Wai Yin Nikita, Centre for Learning, Teaching and Technology, EdUHK

CHENG Yuen Kiu Jessica, Centre for Learning, Teaching and Technology, EdUHK

CHEN Jingtong Michelle, Centre for Learning, Teaching and Technology, EdUHK

5. Keynotes

Keynote 1 - 迈向学习与协作的专业——从 TALIS 数据看上海学校教师特色

Keynote 2 - The Evolution of Quality Assurance in Asian Higher Education in the Post-Pandemic Era: Implications for Higher Education Institutions

Keynote 3 - Teachers who stay: the role of professional identity in teachers' quality retention

Keynote 4 - From Debate to Evidence: Generative AI in Learning and Teaching

Keynote 5 - 透過核心反思連結教師整體性學習中的實踐、理論與個人面向

Keynote 6 - Learning, fast and slow: Empowering learner agency with learning sciences-informed AIED

Keynote 7 - 新時代教師的師德養成與教師教育

Keynote 8 - Challenges and Opportunities for Initial Teacher Education in an Era of Change

Keynote 9 - Theory and Research in Initial Teacher Education – Continuing the Debate

Keynote 10 - 循證教學研究作為認識論實踐：重新思考教師發展、能動性與實踐知識

Keynote 11 - Blind Optimism or Critical Hope? Understanding the work of teachers in extraordinary times

Keynote 12 - What is responsible pedagogy in the age of AI?

Keynote 13 - Poetic Self-Study for Change and Innovation in Teacher Education and Teaching

Keynote 1 - 迈向学习与协作的专业——从 TALIS 数据看上海学校教师特色

Date: 21 April 2026 (Tue) Time: 9:30-10:30
Venue: Conference Centre (E-P-01)
Language: Chinese
Strand: Teacher Education and Teaching

Speaker



张民选教授
Professor ZHANG Minxuan

Professor and Former President of Shanghai Normal University,
Director of Teacher Education Centre under the Auspices of
UNESCO

Moderator



Professor LI Hui
Assistant Vice President (Regional Outreach),
Chair Professor of Early Childhood Education,
Associate Co-Director, Academy for Educational Development
and Innovation,
Director, AI, Brain and Child Research Centre,
Executive Co-Director, Centre for Excellence in Learning and
Teaching, The Education University of Hong Kong

Abstract

TALIS 是由经济合作与发展组织与 2008 年发起的“教师教学国际调查”，2024 年已有 55 个国家/地区的 28 万教师参加。本发言以上海初中教师连续三届参加 TALIS 调查的数据，呈现上海教师终身学习、并在协作中实现专业发展的特色。发言也力图揭示，推进“学习与协作专业”形成的上海教师政策与教师日常实践，包括校本三组（教研组、年级组与科研组）活动、教师培养工程、与教师发展阶梯，等。

Biography

香港大学博士、联合国教科文组织教师教育中心创始主任。曾任上海市政府教育委员会副主任、上海市教育科学研究院院长、上海实验学校校长、上海师范大学校长及联合国教科文组织终身学习研究所理事和联合国国际教育规划研究所顾问。

著有《理想与抉择：大学生资助政策国际比较》、《国际组织与教育发展》和 *How Shanghai Does It, Professionalism and Excellence, Shanghai Teachers' Development* 等著作，发表论文 60 余篇；主持上海 PISA、TALIS 和 SABER 等国际科研项目和中英数学教师交流项目，主持和参与创建联合国教科文组织教师教育中心 (UNESCO-TEC) 和国际教育研究所 (UNESCO-IISTEM)，曾荣获多项国家和省部教育与社科奖励、教学成果奖和亚洲协会首届“创变者奖”。

Prof. ZHANG Minxuan, PhD (University of Hong Kong), the founding director of Teacher Education Centre under the auspices of UNESCO since 2017. He worked as the Principal of Shanghai Experimental School (1997-2005), Deputy President of Shanghai Normal University (2022-2024), Vice Director-general of Shanghai Municipality Education Commission (2004-2010), President of Shanghai Academy of Education Sciences (2005-2010) and President of Shanghai Normal University (2011-2014).

Prof. ZHANG published over 60 papers and 7 books, such as *How Shanghai Does It, Professionalism and Excellence* and *Shanghai Teachers' Development* in English; and *A Comparative Study on the Policies of Student Financial Aids and International Organizations and Education Development* in Chinese.

Prof. Zhang has quite international experience, he was a member of the Advisory Board of UNESCO-IIEP (2006-2012), a board member of UNESCO Institute of Lifelong Learning (2008-2017). He also worked as the National Project Manager for Shanghai PISA, TALIS and SABER. He chaired UK-China Mathematics Teachers Exchange Program, and he also worked as a World Bank and UNICEF education expert for international development.

Keynote 2 - The Evolution of Quality Assurance in Asian Higher Education in the Post-Pandemic Era: Implications for Higher Education Institutions

Date: 21 Apr 2026 (Tue) Time: 10:45-11:45
Venue: Conference Centre (E-P-01)
Language: Chinese
Strand: Quality Assurance in Higher Education and Training

Speaker



Professor YUNG Chi Hou Angela

Professor, College of Education,
Chengchi University, Taiwan

Moderator



Professor YEUNG Siu Sze Susanna

Associate Vice President (Quality Assurance),
Professor, Department of Psychology,
Executive Co-Director, Academy for Educational Development
and Innovation, The Education University of Hong Kong

Abstract

Given the diversity of higher education systems across Asia, quality assurance (QA) frameworks have evolved through three major phases: an initial focus on legitimacy and accountability, followed by an emphasis on internationalization, and more recently, a shift toward diversification. This talk revisits current standard frameworks in higher education and explores emerging quality assurance standards from the perspective of Asian quality assurance agencies. In addition, the study discusses the most critical challenge in developing and implementing these new QA standard frameworks, namely effective stakeholder engagement.

Biography

Angela Yung-Chi Hou is a Professor of Higher Education at the College of Education, Chengchi University, Taiwan. She served as Executive Director of the Higher Education Evaluation & Accreditation Council of Taiwan (HEEACT), accreditor of Taiwan from 2016 to 2021 and has been deeply engaged in quality assurance practice and international research for over 20 years. Her leadership roles include serving as Vice President and Board Member

of both the International Network of Quality Assurance Agencies in Higher Education (INQAAHE) and the Asia-Pacific Quality Network (APQN). In 2024, she was invited by INQAAHE to serve as an international reviewer for accrediting quality assurance agencies worldwide. She is the Editor-in-Chief of the Springer book series “Higher Education in Asia: Quality, Excellence and Governance” and serves on the editorial boards of several peer-reviewed journals in the field of higher education. She is recognized among the world’s top 2% most-cited scholars in the field of higher education quality assurance. She is recognized as the top 5 researcher in field of quality assurance of higher education worldwide according to SCOPUS. In 2025, she is being listed as top 2 % as highly cited scholar by ScholarGPS. She serves as Chief-in-Editor of Higher Education Evaluation and Development (HEED) Emerald and Higher Education in Asia: Quality, Excellence and Governance by Springer, Associate Editor of Journal of Asian Pacific Educational Review (SSCI) and Quality in Higher Education (SCOPUS) and several editorial boards of peer-reviewed journals in higher education field. Up to present, she has published more than 150 English and Chinese journal papers, articles, book chapters, reports and monographs in higher education, international education, and quality assurance. In 2023, she was granted “Outstanding Research Award” by Science and Technology of Council Taiwan and “Excellent Research Award” at Chengchi University. In 2024, She was awarded “the Best Researcher and Teacher” and from 2023-2025, she was awarded as “Best Research Award” by Chengchi University, Taiwan.

Keynote 3 - Teachers Who Stay: The Role of Professional Identity in Teachers' Quality Retention

Date: 21 Apr 2026 (Tue)
Time: 14:00-15:00
Venue: Conference Centre (E-P-01)
Language: English
Strand: Teacher Education and Teaching

Speaker



Professor Christopher W. DAY

Professor of Education, Faculty of Social Sciences
Member of the Centre for Research on Educational Leadership and Management (CRELM)
University of Nottingham, UK

Moderator



Professor GU Ming Yue Michelle

Assistant Vice President (Research),
Professor of the Department of English Language Education,
The Education University of Hong Kong

Abstract

A range of research internationally reveals growing evidence of emotional exhaustion, disenchantment, stress, burnout, and attrition among teachers. This is often associated with unacceptable workloads, curriculum and pedagogical change demands, and pressures of so-called performativity agendas. Together, these are claimed to challenge the resilience of many teachers who stay and their commitment to strive to teach to their best and well. Yet, relatively little is known beyond the individual level about how and why teachers stay in the profession, if not always in the same school, over a career. There is a scarcity of longitudinal data across teachers' life and career courses, and little comprehensive examination and explanation about the combined influences of different layers of the educational eco-system. Drawing upon international research and an in-depth case study of the stories of mid- and later- career teachers in primary and secondary schools in England, this presentation will focus on the key role played by professional identity and values driven agency in teachers' decisions to stay, despite the many challenges that they face. It will discuss the implications for the curriculum of teacher education, professional learning and development, and school leadership.

Biography

Christopher Day is Professor of Education in the School of Education, University of Nottingham. He is Visiting Professor at several universities in Europe, South-East Asia, and the Americas, and recipient of Honorary Doctorates from Linköping University, Sweden, the Education University of Hong Kong. He was awarded the AERA Michael Huberman Award for research on teachers' work and lives. He is judged to be in the top one hundred scholars globally for the range and lifetime impact of his research, Founder of The International Study Association for Teachers and Teaching (ISATT) and founding Editor-in-Chief of *Teachers and Teaching: Theory and Practice*, an international SSCI rated journal. During the last twenty years, he has led national, European and international research and development projects in the areas of teachers' work, lives and effectiveness, school-university partnerships, and successful school principalship. Recent publications include *Educational Research and the Quality of Successful School Leadership* (Paper commissioned for the 2024/25 Global Education Monitoring UNESCO Report "Leadership in Education"); *Going Beyond the 'Effective': How successful principals build and sustain teachers' and students' academic, social and individual learning and achievement* (2024); *Resilient Schools, Resilient Teachers* (2016); and *Teacher Professionalism During the Pandemic: Courage, Care and resilience* (2023).

Keynote 4 - From Debate to Evidence: Generative AI in Learning and Teaching

Date: 21 Apr 2026 (Tue) Time: 15:15-16:15

Venue: Conference Centre (E-P-01)

Language: English

Strand: AI, Metaverse and STEAM Education

Speaker



Professor Dragan GAŠEVIĆ

Professor of Learning Analytics,
Faculty of Information Technology,
Monash University, Australia

Moderator



Professor KONG Siu Cheung

Chair Professor, Department of Mathematics and Information
Technology,
Director, Artificial Intelligence and Digital Competency Education
Centre, The Education University of Hong Kong

Abstract

When generative AI first entered educational discourse, it prompted intense and often polarized debate. Some saw it as a threat to established practices, while others viewed it as a catalyst for innovation. These early reactions were shaped by uncertainty and limited evidence. A growing body of empirical research now enables a more grounded understanding of how generative AI is affecting teaching and learning. This keynote will synthesize emerging evidence on how generative AI is being used to enhance educational practice, and what this implies for learning processes and teaching decisions. It will then examine key concerns related to learner agency, overreliance, and assessment integrity, and consider directions for assessing future-ready skills in AI-mediated environments. Drawing on findings from multiple studies, the talk will argue for a stronger and more diverse evidence base on educational impacts of generative AI, and will conclude with a forward-looking research agenda to guide responsible innovation.

Biography

Dragan Gašević is Distinguished Professor of Learning Analytics and Director of Research in the Department of Human Centred Computing of the Faculty of Information Technology and the Director of the Centre for Learning Analytics at Monash University. Dragan's research interests center around data analytic, AI, and design methods that can advance understanding of self-regulated and collaborative learning. He is a founder and served as the President (2015-2017) of the Society for Learning Analytics Research. He has also held several honorary appointments in Asia, Australia, Europe, and North America. He is a recipient of the Life-time Member Award (2022) as the highest distinction of the Society for Learning Analytics Research (SoLAR) and a Distinguished Member (2022) of the Association for Computing Machinery (ACM). In 2019-2025, he was recognized as the national field leader in educational technology in The Australian's Research Magazine that is published annually. He led the EU-funded SHEILA project that received the Best Research Project of the Year Award (2019) from the Association for Learning Technology.

Keynote 5 - 透過核心反思連結教師整體性學習中的實踐、理論與個人面向

Date: 22 Apr 2026 (Wed) Time: 09:30-10:30

Venue: Conference Centre (E-P-01)

Language: Chinese

Strand: Teacher Education and Teaching

Speaker



陈向明教授

Professor CHEN Xiangming

Professor of the Graduate School of Education,
Peking University, Beijing, China

Moderator



Dr LIU Yiqi April

Assistant Professor, Department of English Language Education
Acting Head, Centre for Language in Education,
The Education University of Hong Kong

Abstract

實踐、理論與教師作為「人」的面向 (teacher as person) 之間的落差，長期以來一直是教師教育中的重要議題。本研究整合了 Korthagen 洋蔥模型的修正版與中國文化資源作為理論框架，探討在中國舉辦的一場敘事行動研究工作坊如何嘗試彌補這一落差。本研究採用質性研究方法蒐集並分析資料，聚焦於一位班主任的「整體性學習」(holistic learning)。研究結果顯示，在引導者帶領下的核心反思 (core reflection)，幫助該教師識別並糾正了其學習中多個層面 (如：行動、認知、情感與志向) 之間的不一致。引導者輔助教師學習的機制包括：1) 透過發人深省的提問，促使教師意識到其實踐中的錯位。2) 引入理論以解釋其係踐為何以及如何產生不一致。3) 透過核心反思，喚起她體現中國文化精髓的核心特質——同理心與慈悲心。本研究的價值在於闡明了中國教師整體性學習的典型文化特徵，這不僅能為中國，也能為世界其他地區的教師教育提供參考。

Biography

陳向明為北京大學教育學院教授，並擔任北京大學基礎教育研究中心名譽主任及教育質性研究中心名譽主任。此外，她亦擔任中國教育學會學術委員會委員、世界課堂研究學會（WALS）理事及華東師範大學特聘研究員。其研究領域主要涵蓋教師教育、課程與教學以及質性研究方法論。她曾先後主持十餘項研究課題，出版專著 20 餘部，發表學術論文 300 餘篇，並榮獲「北京市優秀教師」稱號。

Keynote 6 - Learning, fast and slow: Empowering learner agency with learning sciences-informed AIED

Date: 22 Apr 2026 (Wed) Time: 10:45-11:45

Venue: Conference Centre (E-P-01)

Language: English

Strand: Virtual and Blended Teaching and Learning

Speaker



Professor CHEN Wenli

Associate Dean, Office for Research,
National Institute of Education,
Nanyang Technological University, Singapore

Moderator



Professor SONG Yanjie

Professor, Department of Mathematics and Information
Technology,
Associate Co-Director, Academy for Applied Policy Studies and
Education Futures,
Associate Director, Centre for Excellence in Learning and Teaching,
The Education University of Hong Kong

Abstract

As AI continues to evolve at an unprecedented pace, the educational landscape is being transformed in ways that challenge traditional learning paradigms. This keynote talk will address the intersection of rapid AI advancements and the nuanced, reflective nature of human learning. It will discuss the distinction between AI for learning and AI for performance, urging AIED designers to prioritize genuine “slower” effortful learning processes over “faster” learning outcomes and solutions.

From a learning science perspective, Prof. Chen Wenli will examine how AI-augmented learning environments can be designed not just as tools for quick answers, but as cognitive partners that enhance human agency, foster self-regulation, critical thinking, and metacognitive skills. Drawing on her empirical research, Prof. Chen will share human-centric AIED designs to empower learners and enhance their cognitive capacities, rather than undermining them. This talk advocates a shift in focus from efficiency to meaningful learning, highlighting the importance of human learners’ deep cognitive engagement in human-AI collaboration for learning.

Biography

Professor CHEN Wenli is the Associate Dean of Office for Research at National Institute of Education (NIE), Nanyang Technological University (NTU) Singapore. She is co-chairing NIE's Emerging Technologies Strategic Growth Area, and AIED@NIE. She served as the Head of Learning Sciences and Assessment Department from 2021 to 2025. She specializes in computer-support collaborative learning (CSCL), multi-modal learning analytics (MMLA), and human-centered AI for education (AIED). She has been invited as the keynote speaker for many international conferences. She has won a dozen Best Paper Awards from international conferences. In 2020, the Asia-Pacific Society for Computers in Education presented her with the Distinguished Researcher Award. She received the "Excellence in Research Commendation" "Excellence in Teaching Commendation", and the "Nanyang Education Award" from NIE/NTU.

Professor Chen serves as the Editor-in-Chief for both the Journal of Computers in Education, and Learning: Research and Practice. She also serves as an Associate Editor for Instructional Science, and Research and Practice in Technology Enhanced Learning. Moreover, she is an editorial board member for the International Journal of Computer-Supported Collaborative Learning.

Professor Chen serves on the Board of Directors of the International Society of the Learning Sciences (ISLS). She also served as co-chair of the CSCL Community Committee of the International Society of the Learning Sciences from 2016 to 2021. She is the executive committee member of the Asia Pacific Society of Computers in Education (APSCE) and the Global Chinese Society of Computers in Education (GCSCE).

Keynote 7 - 新時代教師的師德養成與教師教育

Date: 22 Apr 2026 (Wed) Time: 14:00-14:20

Venue: Conference Centre (E-P-01)

Language: Chinese

Strand: Teacher Education and Teaching

Speaker



Professor LEE Chi Kin John, JP

President,
Director, Academy for Applied Policy Studies and Education
Futures,
Director, Academy for Educational Development and Innovation,
Chair Professor of Curriculum and Instruction,
The Education University of Hong Kong

Moderator



Professor XU Guandong

Assistant Vice President (Artificial Intelligence and Education
Innovation),
Chair Professor of Artificial Intelligence, Director of University
Research Facility of Data Science and Artificial Intelligence,
The Education University of Hong Kong

Abstract

本演講從多個角度探討新時代教師的師德養成與教師教育。隨著今年《中華人民共和國民族團結進步促進法》的出台，以及人工智能的迅速發展，對師德教育提出了新的要求。在理論層面上，以至聖先師孔子為典範，通過研讀《論語》中的相關內容，歸納師德的基本內涵與實踐原則。在比較與實踐層面，進一步比較了中國內地、香港特別行政區及其他國家在教師專業信念建構與師德培養方面的制度與做法，並探討教師職業倫理與個人品德之間的關係，分析了教育家精神在當代的重要意義。此外，本演講以香港教育大學（教大）作為案例，介紹教大在師德培養及價值教育方面的實踐，涵蓋師德教育、國家安全教育、中華文化教育，以及「大思政」相關教育等，表明教大高度重視立德樹人，致力於培養具備家國情懷與專業操守的優秀人才。

Biography

Professor John Lee Chi-Kin, President and Chair Professor of Curriculum and Instruction, joined The Education University of Hong Kong (the then Hong Kong Institute of Education) in 2010. He was Vice President (Academic) from 2010 to 2019, and Vice President (Academic) and Provost from 2019 to 2023. Professor Lee was previously Dean of Education and a Professor at the Department of Curriculum and Instruction at The Chinese University of Hong Kong (CUHK). He was also the Director of the Centre for University and School Partnership and served as a Fellow of United College and Morningside College at CUHK. Professor Lee was a recipient of The Vice-Chancellor's Exemplary Teaching Award 1999 at CUHK. Before that, he worked as a secondary school teacher and as a Lecturer in the Sir Robert Black College of Education.

Professor Lee graduated from The University of Hong Kong and subsequently received an MSc degree from the University of Oxford, and an MA (Education), PhD and Diploma in Education (with distinction) from CUHK. His research interests focus on curriculum and instruction, geographical and environmental education, life and values education, and teacher development and school improvement. He is active in leading education research and development projects and has a solid track record in securing external grants. Professor Lee was named among the top 1% most-cited scientists in the world in terms of career-long impact, in the latest list released by Stanford University. He was a Fellow of the Hong Kong Primary Educational Research Association.

Professor Lee has served as Editor of the International Journal of Children's Spirituality, Executive Editor of Teaching and Teacher Education and editorial board member of Teachers and Teaching, as well as an editorial board members or advisory editor of many local, regional and international journals. He is also a prolific writer, having edited and written more than 25 books, and published over 175 journal articles and book chapters. He is the leading co-editor of the Springer book series, Curriculum and School Development in Asia and Education for Sustainability, as well as The Routledge Series on Life and Values Education and The Routledge Series on Chinese Language Education.

Professor Lee has actively participated in education and social service in Hong Kong, Chinese Mainland and overseas. He has held many visiting, guest and adjunct professorships at universities overseas and in Chinese Mainland. He has served as Changjiang Scholar Chair Professor, conferred by the Ministry of Education of the People's Republic of China. He has served as Honorary Advisor (Education) of Sik Sik Yuen, the Hong Kong Kindergarten Association, and the Hong Kong Federation of Education Workers; as Advisor of the Character Education Foundation (CEF) and the Hong Kong Association of Deputy Principals; as Academic Advisor of the Association of Inspectors, Education Bureau (AIEDB), and so forth. He is also a Member of the Academic Committee of the Guangdong-Hong Kong-Macao Greater Bay Area Primary and Secondary Schools Principal Federation and Chairman of the Academic Committee of the Center for Hong Kong and Macao Research of South China Normal University. In addition, he was appointed by the Hong Kong SAR Government as a Justice of the Peace (JP).

Professor Lee is a member of the 14th National Committee of the Chinese People's Political Consultative Conference, the UNESCO Chair in Regional Education Development and Lifelong Learning (2019-2023; 2023-2027), a Research Fellow of The Southeast Asian Ministers of Education Organization (SEAMEO), and Director of the Academy for Applied Policy Studies and Education Futures, Academy for Educational Development and Innovation, and Centre for Religious and Spirituality Education at EdUHK.

Keynote 8 - Challenges and Opportunities for Initial Teacher Education in an Era of Change

Date: 22 Apr 2026 (Wed) Time: 16:30-16:50

Venue: Conference Centre (E-P-01)

Language: English

Strand: Teacher Education and Teaching

Speaker



Professor Cheng May Hung May

Vice President (Academic),
Executive Co-Director, Academy for Applied Policy Studies and
Education Futures,
Chair Professor of Teacher Education,
The Education University of Hong Kong

Moderator



Professor CAI Yuzhuo

Professor, Department of Education Policy and Leadership,
Co-Director, Global Research Institute for Finnish, European and
Global South Education,
The Education University of Hong Kong

Abstract

In an era characterised by rapid globalisation, accelerated technological advancement and pervasive societal transformation, educational systems worldwide are being compelled to respond proactively to what the Organisation for Economic Co-operation and Development (OECD, 2018) describes as a VUCA environment, marked by volatility, uncertainty, complexity and ambiguity. Economic restructuring, political contestation and evolving cultural norms now exert continuous influence on Initial Teacher Education (ITE) governance, reframing what were once episodic disruptions as enduring features of the sector.

This presentation first examines how ITE systems globally have been reshaped by the challenges and opportunities arising from major drivers of change. It foregrounds discussion of policy priorities, cultural-historical legacies and local realities, while identifying patterns of convergence and divergence in ITE practice that emerge from the dynamic interplay of global pressures, local reform, data-intensive policy instruments, emergent technologies, resource disparities and demographic shifts.

Against this backdrop, Hong Kong is situated within a context of profound, multidimensional change, influenced both by global trends and by local demographic dynamics and newly articulated guidelines and standards concerning teachers' professional roles, conduct and ethics. The presentation concludes with a case analysis of The Education University of Hong Kong, showing how we have realigned curricula and programmes to address local and national imperatives in ITE.

Biography

Professor May Cheng May-hung is currently Vice President (Academic) and Chair Professor of Teacher Education of The Education University of Hong Kong (EdUHK).

Professor Cheng began her teacher education work at the Sir Robert Black College of Education in 1990. As a long-serving member of EdUHK and the former Hong Kong Institute of Education, she has taken up academic leadership positions at different stages, such as Associate Vice President (Academic Affairs), Registrar, Acting Dean of the Faculty of Arts and Sciences, Associate Dean (Programmes), and Programme Director. Between 2010 and the end of 2011, Professor Cheng was a Reader in Professional Education in the Department of Education at the University of Oxford, and a fellow of the Governing Body at Kellogg College.

Professor Cheng graduated from The University of Hong Kong with a BSc (First-class Honours) degree, a Certificate in Education (Distinction) and a Master's in Education. She obtained a PhD at the University of Waikato, New Zealand. She served as President of the East Asian Association for Science Education (EASE) from 2016 to 2019. Professor Cheng has actively participated in and made contributions to the international teacher education and science education arena.

She has been an International Committee member of the National Association for Research in Science Teaching in the US, and has chartered status as a fellow of the Royal Society of Biology in the UK. She is on the editorial boards of various international journals, such as Cogent Education, Teaching and Teacher Education, Teachers and Teaching, and Asia Pacific Journal of Teacher Education. She has obtained various research and project grants from the General Research Fund, the Quality Education Fund and the Education Bureau. She is also a prolific writer, having edited and written more than 13 books and published over 140 journal articles and book chapters.

Professor Cheng has actively participated in education services in Hong Kong. She was appointed a registered auditor of the Quality Audit Committee under the University Grants Committee (UGC), a specialist and member for institutional review by the Hong Kong Council for Accreditation of Academic and Vocational Qualifications, a member of the Council of the Hong Kong Examinations and Assessment Authority (HKEAA) and to the Curriculum Development Council. She has also served on various subject committees at the HKEAA, the Curriculum Development Committee of the Curriculum Development Institute, and the Education Committee at the Maritime Museum. Professor Cheng is also an elected Academic Board representative on the Council of EdUHK.

Keynote 9 - Theory and Research in Initial Teacher Education – Continuing the Debate

Date: 22 Apr 2026 (Wed) Time: 16:50-17:50

Venue: Conference Centre (E-P-01)

Language: English

Strand: Teacher Education and Teaching

Speaker



Professor John Furlong

Emeritus Professor of Education
University of Oxford, United Kingdom

Moderator



Professor CHENG May Hung May

Vice President (Academic),
Chair Professor of Teacher Education,
Executive Co-Director, Academy for Applied Policy Studies and
Education Futures,
The Education University of Hong Kong

Abstract

The debate about the role of theory and research in teacher education is long standing and deeply contested, indeed it is a debate that goes right back to the beginning of organised teacher education itself. At its heart lie questions about how different forms of professional knowledge relate to each other; how propositional knowledge, derived from research and theory, relate to knowledge and experience derived from the actual practice of teaching - teaching these pupils, this curriculum in this classroom. It is now twelve years since I chaired the BERA (British Educational Research Association) and RSA (Royal Society of Arts) inquiry into the role of Research in Teacher Education. Much has happened since that time. On the one hand there has been the international move towards more practically focused, 'school-based' forms of training; on the other hand, we have seen the rise of the 'what works' movement with its focus on the 'science' of teaching. In this paper I intend to continue the debate, particularly focusing on the strengths and weaknesses of different models for linking theory and practice. I will argue that in reviewing the effectiveness of any particular model, we need to pay close attention both to its implicit pedagogy as well as its curriculum – both the 'how' and the 'what' of professional learning.

Biography

John Furlong is a former Director of Oxford's Department of Education, having previously held posts at Bristol, Cardiff, Swansea and Cambridge Universities. A former President of the British Educational Research Association (BERA), he was until recently an adviser to the Welsh Government on Initial Teacher Education (ITE) having been author of a number of government reports on this topic over the years. In 2022, he and colleagues from Oxford were awarded the BERA Public Engagement and Impact prize in recognition of their work on the reform of teacher education in Wales. In 2015, his book 'Education – an anatomy of the discipline' was awarded first prize by the British Society for Educational Studies for the best educational research book of the year. John Furlong is an elected Fellow of the Academy of Social Sciences and has been a member of Research Excellence Framework (REF) sub-panels in Education in the UK, Hong Kong, Latvia, Luxembourg and Portugal. He was awarded the OBE for services to educational research and advice to government in 2017.

Keynote 10 - 循證教學研究作為認識論實踐：重新思考教師發展、能動性與實踐知識

Date: 23 Apr 2026 (Thu) Time: 9:30-10:30

Venue: Conference Centre (E-P-01)

Language: Chinese

Strand: Teacher Education and Teaching

Speaker



宋萑教授

Professor SONG Huan

Professor of the Center for Teacher Education Research,
Associate Dean, Faculty of Education,
Beijing Normal University, Beijing, China

Moderator



Dr. HUANG Xianhan Yvonne

Associate Professor,
Department of Curriculum and Instruction (C&I)

Abstract

教師專業發展的根本關切在於專業判斷的形成。其核心在於知行合一：這是一個非二元對立的過程，在此過程中，科學與藝術、證據與經驗不被視為分離的領域，而是在教育實踐中建立起富有成效的關聯。從這個視角來看，實證取向的教學研究（教研）不僅是改進教學的技術性工具，更是一種認識論的實踐——教師透過這種實踐來探究、詮釋並重構實踐本身。其生成性的潛能，在於它重新配置了專業認識的條件。我們針對中國大陸人工智慧增強的實證教研所做的研究發現，證據與數據不僅作為外部資源發揮作用，更作為關鍵的邊界物件，在集體探究的共享框架中，使實踐經驗、研究證據與技術表徵之間的差異得以顯現並被協商。在此過程中，教師並不將證據視為確定性的答案或外部指令，而是將其作為理解教學問題、重新審視經驗判斷、反思教學決策的參照點。因此，教師發展並非外於教師能動性，而是透過能動性得以實現。實證教研的意義，並不在於提供現成的解決方案，而在於創造認識論與實踐的條件，使實踐知識與專業智慧得以共同生成。

Biography

宋萑教授是教育領域的傑出學者，專長於教師教育及課程與教學論。現任北京師範大學教育學部教授、博士生導師，同時擔任學部副部長及教育部重點研究基地教師教育研究中心副主任。獲評國家級重大人才計畫青年學者、仲英青年學者，主持國家級及省部級科研項目二十餘項，在 SSCI 及 CSSCI 期刊發表學術論文逾一百二十篇，提交多份政策諮詢報告，並出版多部專著。此外，他兼任華東師範大學兼職教授、香港教育大學高級研究員。在學術組織中積極任事，包括擔任中國高等教育學會教師教育分會副秘書長，並在中國民主促進會中擔任要職。他致力於建構具有中國特色的教師教育理論體系，服務國家高品質教育體系建設，並透過人工智慧融合與實證導向的路徑，推動教師教育的創新發展。

Keynote 11 - Blind Optimism or Critical Hope? Understanding the work of teachers in extraordinary times

Date: 23 Apr 2026 (Thu) Time: 10:45-11:45

Venue: Conference Centre (E-P-01)

Language: English

Strand: Teacher Education and Teaching

Speaker



Professor Kelly Freebody

Head of School,
Sydney School of Education and Social Work,
The University of Sydney, Australia

Moderator



Professor Alfredo BAUTISTA

Professor and Associate Head,
Department of Early Childhood Education,
The Education University of Hong Kong

Abstract

This presentation considers the critical questions driving teacher education in 2026. It is based on the foundational idea that Education, at its core, is a hopeful undertaking. Societies invest significant amounts of money and energy ensuring a robust education systems which is predicated on the belief that all children can and should learn, grow and change, and that the society has history, knowledge and culture that is of value to the next generation. Since the introduction of mass education systems globally, many have written about the purpose of schooling, and whether schools, policies, and (critically) teachers are 'fit for purpose'.

Drawing on poststructuralist methodologies, I explore how pedagogical and ideological ideas are enacted in the complex policy, institutional and relational settings of the classroom, in both schools and teacher education programs. Using a framework to unpack the complex forces that are brought to bear on the everyday work of teachers and teacher educators, I consider how the purpose of schooling is positioned and how this positioning impacts the work of teachers and teacher educators around the world.

Biography

Kelly Freebody is a Professor and Head of the Sydney School of Education and Social Work, The University of Sydney. Kelly has held several leadership positions throughout her career, including Associate Dean of the Faculty of Arts and Social Sciences, and Program Director of Secondary Education. Her teaching in the Secondary Education program focuses on creative and critical pedagogy, school-community relationships, and pedagogies of hope.

Kelly's research merges her key interests in drama, education, creativity and social justice. It seeks to develop theoretical and practical understandings of the ways in which drama of, for, and about social change operates in a variety of institutional and educational settings. Using innovative methodologies drawn from the fields of critical policy studies, ethnomethodology, sociology, and education, her work aims to provide new perspectives for researchers and practitioners in applied theatre, drama education, and creativity education.

Keynote 12 - What is responsible pedagogy in the age of AI?

Date: 23 Apr 2026 (Thu) Time: 14:00-15:00
Venue: Conference Centre (E-P-01)
Language: English
Strand: Digital Humanities

Speaker



Professor Miriam Posner

Associate Professor,
Information Studies and Digital Humanities,
University of California, Los Angeles, United States

Moderator



Dr. Jeffrey CLAPP

Associate Professor
Department of Literature and Cultural Studies,
The Education University of Hong Kong

Abstract

Almost as soon as ChatGPT made its entrance in 2022, teachers were besieged by opinions about how they should respond. Is the teacher's job to incorporate LLMs in lesson plans? To show students how to use LLMs "responsibly"? To banish the technology from the classroom? I argue for an approach that acknowledges AI's dual identity as both a package of technologies and the encapsulation of powerful socioeconomic forces. Our responsibility as educators includes the obligation to make students aware that they are targets and sources of data for vendors of educational technology.

Biography

Miriam Posner is an associate professor at UCLA in the Department of Information Studies. She's also a digital humanities scholar with interests in labor, race, feminism, and the history and philosophy of data. Miriam has published widely on technology, data, and the humanities. Her book, *Seeing Like a Supply Chain: Data in the Circuits of Global Trade*, tells the story of the technology that makes supply chains work, from punch-cards to neural nets. It will be published in the fall of 2026 by Yale University Press.

Keynote 13 - Poetic Self-Study for Change and Innovation in Teacher Education and Teaching

Date: 23 Apr 2026 (Thu) Time: 16:20-17:20

Venue: Conference Centre (E-P-01)

Language: English

Strand: Teacher Education and Teaching

Speaker



Professor Kathleen PITHOUSE-MORGAN

Professor of Education, University of Nottingham, United Kingdom
Honorary Professor, University of KwaZulu-Natal, South Africa,
Co-Editor, Teaching and Teacher Education,
Co-Convenor, Centre for International Education Research, School of Education, University of Nottingham

Moderator



Professor MA Qing Angel

Professor, Department of Linguistics and Modern Language Studies,
Associate Dean (Research and Postgraduate Studies), Faculty of Humanities,
The Education University of Hong Kong

Abstract

This keynote explores poetic self-study as a creative and transformative research approach that contributes to innovation in teaching and teacher education. Grounded in arts-based and self-reflexive inquiry, poetic self-study promotes collaborative creativity and learning, enabling educators to engage deeply with their lived experiences. It bridges personal reflection with broader educational impact by enhancing learning opportunities for both teachers and those affected by their professional practices. The presentation traces the genre's development from its 1990s origins to its global reach, using poetic personal narrative and vignettes from diverse academic contexts. Poetry is shown to support self-exploration, critical dialogue, and imaginative expression, while also cultivating understandings of educational experience that may elude conventional academic forms. A central meta-analysis offers theoretical insights and practical guidance. Through poetic self-study, educators envision ethical and hopeful possibilities for professional practice, contributing to more inclusive, responsive, and socially just approaches to teacher education and teaching.

Biography

Dr Kathleen Pithouse-Morgan serves as a Professor of Education at the University of Nottingham's School of Education and an Honorary Professor at the University of KwaZulu-Natal. Specialising in professional learning, self-reflexive scholarship, and arts-based educational research, her work emphasises the generative power of collaborative reflexivity and creativity in teaching and teacher development. Dr Pithouse-Morgan's dedication to methodological and theoretical innovation for social change has led to transnational collaborations that spotlight the contributions of the Global South to educational research. Her recent collaborative book publications include *Arts-Based Educational Research Narratives of Academic Identities: Perspectives from Higher Education* (2024) and *Poetic Inquiry for the Social and Human Sciences: Voices from the South and North* (2024).

6. Panel Discussion

Panel Discussion 1 - AI-Driven Transformation: Reclaiming Educator Agency in the Digital Landscape

Date: 21 April 2026 (Tuesday)

Time: 4:30 PM – 6:00 PM

Venue: Conference Centre (E-P-01)

Language: English

Abstract

This panel discussion, “*AI-Driven Transformation: Reclaiming Educator Agency in the Digital Landscape*,” explores the evolving role of teachers in an AI-rich future. Chaired by Prof. Michelle Gu and featuring experts from across Asia and Australia, the session examines how strategic investments and systemic support can empower educators as high-agency professionals augmented by technology. Panelists will discuss critical themes including teacher identity, educational equity, emotional agency, and social connectedness. The session aims to offer actionable insights for reclaiming professional autonomy amid rapid digital change.

Chair



Prof GU Mingyue Michelle

Assistant Vice President (Research)

Professor of the Department of English Language Education
The Education University of Hong Kong

Distinguished Panelists



Dr. HjH Hardimah Binti Haji Mohd SAID

Dean, Sultan Hassanah Bolkuah Institute of Education,
Universiti Brunei Darussalam



Prof. YANG Xin

Professor, Northwest Normal University



Prof ZHANG Qian

Professor, Capital Normal University



Professor YIN Hongbiao

Chairperson and Professor, Department of Curriculum and Instruction Director, Hong Kong Institute of Educational Research, The Chinese University of Hong Kong



Professor Kate REYNOLDS

Professor of Educational Psychology & Learning, Faculty of Education, The University of Melbourne

Panel Discussion 2 - 駕馭轉型——重塑創新時代的教育者角

日期: 2026 年 4 月 22 日 (星期三)

時間: 下午 2:00 – 3:15

地點: 香港教育大學會議中心 (E-P-01)

語言: 中文 (普通話)

摘要

「駕馭轉型——重塑創新時代的教育者角色」圓桌論壇，由李子建教授主持，匯聚多位教育領袖與專家。討論核心圍繞教育者如何在科技變革中堅守教育初心與主動創新之間的平衡。議題涵蓋師生主體性關係、教師情緒福祉、專業身份認同轉換及評價機制改革等維度。與會嘉賓將共同探討如何支持教師從知識傳授者轉型為終身學習者與學術引路人，在高科技浪潮中重塑專業能動性。

主持人



李子建教授

香港教育大學

校長

課程與教學講座教授

聯合國教科文組織區域教育發展與終身學習教席

嘉賓



馮建軍 教授

南京師範大學

教師教育學院院長

教育部人文社科重點研究基地南京師範大學道德教育研究所所長



李盛兵 教授

華南師範大學

教育科學學院院長

教育部區域與國家研究基地華南師範大學港澳研究中心執行主任



趙英 教授

山西師範大學
教育科學學院院長



邱德峰 副教授

西南大學
教師教育學院副教授



孫彩霞 副教授

湖州師範大學
教師教育學院學前教育系系主任

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Strand 會議主題

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教師教育與教學

AI, Metaverse and STEAM Education

人工智能、元宇宙及 STEAM 教育

Virtual and Blended Teaching and Learning

虛擬與混合教學與學習

Digital Humanities

數碼人文

Quality Assurance in Higher Education and Training

高等教育與培訓的質素保證

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其他與學習、教學和評估相關的主題

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Strand

Teacher Education and Teaching

教師教育與教學

Integrating Savouring into Teacher Training: A Conceptual Framework for Mitigating Burnout and Enhancing Efficacy in Special Educators

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ABSTRACT

Special education teachers are disproportionately affected by occupational burnout and diminished self-efficacy due to the intense emotional and cognitive demands of their roles. Traditional support models often focus on reactive stress management, neglecting proactive resource-building. Grounded in the Conservation of Resources (COR) Theory and Broaden-and-Build Theory, this paper proposes a novel conceptual framework for integrating savouring interventions into teacher training programs. Savouring, the process of actively attending to, enhancing, and prolonging positive experiences, is posited as a mechanism to counteract resource depletion. We detail a structured, multi-component intervention program based on Bryant and Veroff's temporal model of savouring (reminiscing, present-moment savouring, and anticipatory savouring). The proposed program is designed to be embedded within existing professional development structures. We hypothesize the intervention's impact through a defined mediating pathway: by cultivating positive affect, the intervention strengthens psychological resources, thereby boosting self-efficacy and concurrently reducing the three dimensions of burnout (emotional exhaustion, depersonalization, and reduced personal accomplishment). This paper contributes to the field by: (1) introducing a theoretically-grounded, innovative approach to teacher well-being; (2) providing a actionable blueprint for pre-service and in-service training; and (3) outlining a clear agenda for future empirical validation. This shift from deficit-based to strength-based support represents a paradigm change in how we sustain the well-being and effectiveness of special education professionals.

KEYWORDS

Special Education Teachers, Teacher Burnout, Self-efficacy, Savouring Intervention, Positive Psychology

Evolving Competencies in Hong Kong Kindergarten Teachers: Historical Context, Leadership Perspectives, and Implications for Teacher Education

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ABSTRACT

This paper critically examines the evolution of kindergarten teacher competencies within the context of Hong Kong's early childhood education sector, spanning historical developments from the 1950s to the present. It first traces the sector's transition from an academically oriented and didactic kindergarten curriculum to a more child-centered, holistic, and inclusive approach, highlighting key policy reforms, rising professional qualification requirements, and the increasing complexity of teacher roles. The study draws on documentary analysis, policy review, and in-depth interviews with two experienced kindergarten principals to explore contemporary understandings and priorities regarding teacher competencies. The findings reveal both convergence and divergence in principal perspectives: while both value foundational pedagogical skills and teamwork, one principal emphasizes moral character, emotional regulation, and reflective practice, and the other prioritizes specialized knowledge, creativity, and proactive engagement with families. These differing emphases are analyzed in relation to the Teacher Competencies Framework and situated within the sector's ongoing challenges, such as declining teacher numbers, demographic shifts, and the need for digital literacy and inclusive practices, especially in the post-pandemic era. The analysis underscores the multifaceted and evolving nature of teacher competence in Hong Kong, shaped by both policy imperatives and local leadership priorities. The paper concludes with implications for teacher education, advocating for comprehensive reforms that foster pedagogical flexibility, emotional intelligence, digital competence, and innovation to prepare future educators for the complex demands of contemporary early childhood classrooms.

KEYWORDS

teacher competency, principal, leadership, kindergarten

Leveraging Blockchain and NFTs for Sustainable Education and ESG Goals: A

Critical and Balanced Perspective

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ABSTRACT

My exploration into blockchain and Non-Fungible Tokens (NFTs) began with their promise to revolutionize sectors like finance and art. This reflective analysis critically examines my findings on their application within Environmental, Social, and Governance (ESG) frameworks and education, moving beyond theoretical hype to present a balanced view. In the ESG domain, this research highlights how blockchain's transparency and smart contracts can automate the verification of carbon credits, enhancing trust. Furthermore, the study of Carbon Credit NFT marketplaces demonstrated how tokenizing real-world assets could democratize investment in eco-friendly initiatives. In education, this investigative journey revealed blockchain's potential to foster social inclusion and preserve cultural heritage. For instance, my experience in organizing a Chinese Composition Competition demonstrated how student work celebrating cultural stories could be minted as NFTs, creating a permanent, verifiable archive of cultural expression and providing tangible recognition to participants. Similarly, a Wall Painting Competition focused on environmental themes showed how digital certificates of participation and ownership of the art could be issued on a blockchain, immortalizing community contributions and promoting shared cultural values. These experiences align with a framework for "educational commons"—decentralized, community-governed knowledge ecosystems that advance UN Sustainable Development Goals (SDGs). This critical exploration examines blockchain and NFTs in ESG and education. Their transparency can enhance carbon credit verification and create trusted environmental markets. Significant barriers persist, including the scalability trilemma, environmental impacts, regulatory ambiguities, and digital divide risks. Realizing potential requires responsibly addressing these technical and social constraints.

KEYWORDS

Blockchain, Non-Fungible Tokens, Sustainable Development Goals, Environmental, Social, and Governance

Redefining Personalized Education: Eye-Tracking Insights into Attention

Dynamics Among Young Children with Lower English Proficiency

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Abstract: *This study employs eye-tracking technology to investigate the cognitive processes of forty-four new primary one students, aged 5.5 to 6.5 years, who had lower English standard. The students' fixation duration was examined to assess their interactions with educational materials. The results revealed that the average duration of students' attention to instructional text was significantly higher when the text was explained in Chinese with the teacher's presence, compared to other conditions. These findings inform the development of customized learning resources to enhance engagement and comprehension in English. This approach addresses each student's unique needs while fostering an inclusive environment that promotes academic growth and success. The study provides significant empirical evidence to redefine personalized education and demonstrates the transformative potential of innovative assessment approaches in the classroom.*

Keywords: Eye-tracking Technology, Special Educational Needs, Individualized Instruction

1. Introduction

In the context of bilingual education in Hong Kong, teaching English to children with lower English input presents unique challenges. Traditional assessment approaches struggle to capture the cognitive processes of these children objectively. Students aged under seven are not accepted for standardized Special Educational Needs (SEN) tests, making eye tracking an alternative assessment method. The lack of systematic exploration of the synergistic effects of visual aids, such as two-dimensional (2D) images, and native language support in second language learning for children warrants further study. In this research, eye-tracking technology was innovatively employed to reveal the cognitive load characteristics of students in English language learning by examining differences in fixation duration during exposure to multimodal instructional stimuli. This approach allows for developing targeted instructional strategies that meet each educational stage's unique language development needs, promoting optimal academic development in English language learning.

According to cognitive load theory, this study addresses the empirical gap in multimodal teaching and learning within Hong Kong kindergartens. It provides a scientific basis for developing individualized interventions that target the cognitive characteristics of young children. The study uses objective physiological data to support data-driven differentiated teaching and learning in an integrated education setting. The findings inform the development of customized learning resources to enhance engagement and comprehension in English. This approach addresses each student's unique needs while fostering an inclusive environment that promotes academic growth and success. This initiative will redefine personalized education, showcasing the transformative potential of innovative assessment methods in the classroom.

2. Literature review

2.1. Cognitive Load Theory and Attention Allocation Mechanisms

Eye-tracking technology has introduced a new research paradigm to uncover the cognitive processing mechanisms of children with learning difficulties (Lai et al., 2013; Mulvany et al.; Sundstedt, 2012). Cognitive load theory classifies cognitive load into three dimensions: Intrinsic Load (the intrinsic difficulty of the task), Extraneous Load (the extra burden triggered by the instructional design), and Germane Cognitive Load (the cognitive inputs that facilitate learning) (Iqbal, 2015; Mutlu-Bayraktar et al., 2019). Cognitive load theory helps explain how children with learning differences pay attention. Skulmowski and Xu (2022) suggest that learning materials should reduce unnecessary cognitive load and increase helpful cognitive load. Previous studies show that using 2D pictures and explanations in the first language can help students build on their current knowledge to improve their second language skills.

2.2. Application of Eye-Tracking Technology in Cognitive Load Assessment

Eye-tracking technology captures and analyzes eye movements to infer fixation points, attention distribution, and cognitive processes (Sun et al., 2019; van der Schoot et al., 2012). This innovative approach enables real-time measurement of cognitive load by recording metrics such as fixation trajectories and changes in pupil diameter. By accurately measuring fixation duration—indicative of cognitive resource allocation—and fixation switching frequency—reflecting attentional

stability—eye-tracking provides an objective means to quantify cognitive load. Through eye movement data, researchers can indirectly assess learners' attention allocation, information processing, and cognitive load (Josupeit, 2022).

In education, eye-tracking has been utilized to analyze student and teacher behavior by measuring parameters such as fixation duration, number of fixations and pupil size. This methodology offers insights into cognitive processes during lessons and learning activities. Researchers noted that eye tracking captures attentional nuances and fixation times, helping to identify potential learning difficulties that traditional assessments may overlook. Particularly, eye tracking plays a crucial role in assessing vocabulary development among young children, providing immediate insights into their interactions with linguistic materials and cognitive processes (Ferguson & Breheny, 2011; Holmqvist et al., 2011; Huettig et al., 2011). Moreover, eye-tracking technology enhances understanding of how special needs students perceive and process information, facilitating the development of tailored instructional methods to better support their learning. Thus, eye tracking serves as an objective measure of cognitive engagement, enabling educators to customize interventions to improve educational outcomes for children with diverse learning needs through enhanced data quality and methodologies (Evans & Saint-Aubin, 2005)

This study investigates the effects of text presentation, relevant visual images, and L1 explanations—both with and without an instructor—on the learning processes and outcomes of Hong Kong kindergarteners acquiring English as a second language. However, there is a notable scarcity of research exploring the effectiveness of videos in measuring children's vocabulary learning outcomes. Furthermore, comparative studies examining the impact of 2D images and L1 explanatory support on the language learning process remain limited.

2.3. Development of Research Question

Previous studies have primarily focused on a single type of disorder, resulting in relatively homogeneous samples and overlooking students with other types of learning difficulties. This study systematically examines the visual attention characteristics of 5.5- to 6.5-year-old children with high and low English standard young students. The research aims to address the following questions:

2.3.1. To what extent do the presence of an instructor, the use of Chinese explanations, and the use of 2D enhance the English language learning outcomes for young Chinese children?

2.3.1.1 It is hypothesized that young Chinese children, particularly those with higher English proficiency, have already developed a reading habit. Consequently, they are expected to read the passage more thoroughly, resulting in longer fixation durations in the text Area of Interest (AOI).

2.3.1.2 It is hypothesized that young Chinese children with lower English proficiency will rely more on Chinese words or pictures in their first language than children with higher English proficiency, resulting in longer fixation times.

3. Methodology

This study employed a rigorous experimental design that integrated eye-tracking technology and customized teaching protocols to systematically examine the effects of different teaching methods on English vocabulary acquisition among kindergartens in Hong Kong. The focus was on two core teaching strategies: visual aids (2D pictures) and Chinese explanations. Comparative experiments aimed to elucidate the mechanisms through which these strategies facilitate vocabulary learning, highlighting the flatness of 2D images versus the cognitive bridge provided by Chinese explanations in a bilingual learning context. Together, these elements formed an innovative research framework for exploring young children's multimodal vocabulary acquisition processes.

3.1. The Roles of Pictures and L1 Explanations in Vocabulary Building

The importance of visual aids for vocabulary building in language learners is well-recognized (Mayer et al., 2014). To support students, individualized instruction is employed, incorporating visual aids and multisensory activities. Structured lesson timings with focused work bursts and breaks are implemented, consistent feedback is provided, and regular parent-teacher meetings are held to discuss strategies and progress. This approach fosters collaboration and promotes academic and social development in an inclusive classroom environment.

Additionally, the innovation of the research methodology is reflected in the combination of objective measurements from eye-tracking technology and instructional interventions. By recording real-time eye-movement trajectories, such as fixation duration and pupil diameter, of young children exposed to different instructional materials and combining these with vocabulary test scores, the effects of visual representation depth (2D) and Chinese support on cognitive load and learning effectiveness can be accurately analyzed. This multidimensional assessment system validates established theories, such as Dual Coding Theory and Cognitive Load Theory. It provides empirical evidence for teaching English to young children in a bilingual context in Hong Kong. It particularly reveals the synergistic effects of visual aids and mother tongue transfer in early language development.

3.2. Application of Eye-tracking Technology in Experiments

The eye-tracking data collected in this study included participants' gaze locations, fixation durations, and movements between fixations, known as "saccades." These eye movement patterns are believed to correlate with the cognitive and attentional demands of the tasks (Duchowski, 2007), allowing for a detailed understanding of the cognitive effort required during each sentence segment. The eye-tracking experiment was conducted at the Speech and Language Sciences Laboratory at The Hong Kong Polytechnic University. Eye movements were recorded using a Tobii eye tracker, which features a simple calibration process designed to minimize discomfort for young children. To ensure participants felt at ease with the equipment and laboratory environment, they were given opportunities to familiarize themselves with the setup prior to the tests. Additionally, a warm-up task was incorporated into the eye-tracking experiment to help participants acclimate to the technology and understand the task requirements, fostering a comfortable testing experience.

3.3. Participants

The eye-tracking assessment program spanned from (2022-2024) expanded to thirty-two students, providing broader insights into reading behaviours. The eye-tracking analysis examined children's fixation behaviours across four video groups, focusing on specific Areas of Interest (AOIs) (Figures 1 to 4).

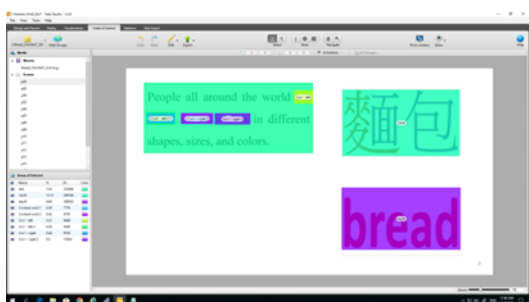


Figure 1. The AOIs of the Text, the Chinese Explanation and the Target Word for the Video of without an Instructor

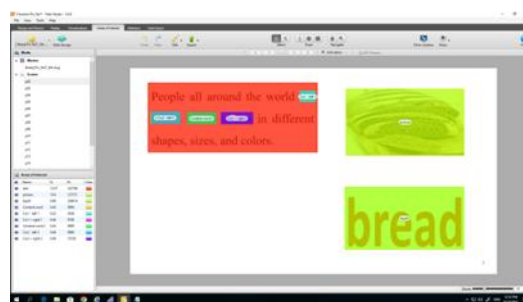


Figure 2. The AOIs of the Text, the Picture and the Target word for the Video of without an Instructor



Figure 3. The AOIs of the Text, the Chinese Explanation, the Target Word and the Face of the Instructor for the Video of with an Instructor

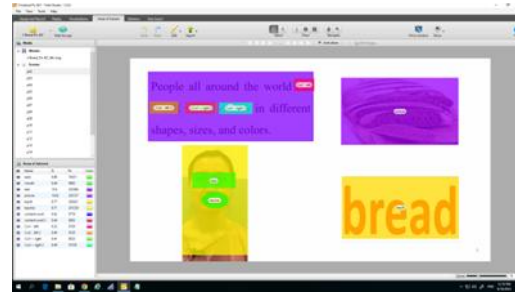


Figure 4. The AOIs of the Text, the Picture, the Target Word and the Face of the Instructor for the Video of with an Instructor

3.4. Reflection on Teaching and Learning

The fixation duration and gaze paths were analyzed to explore how teaching approaches and the presence of an instructor affect student engagement. The analysis revealed that different approaches, such as L1 explanations, influence visual attention. For instance, some students focused more on the instructor, while others preferred visual aids. The research questions examined the reading habits and language reliance of young children with varying levels of English proficiency (Figures 5 & 6).

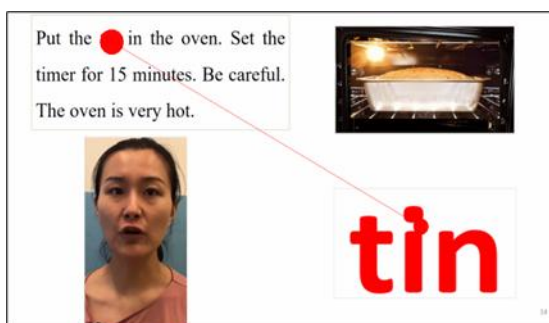


Figure 5. Reading performance using keywords (text and picture)



Figure 6. Reading performance using visuals (text and picture)

4. Summary of Findings

The total fixation time results significantly differed between the different video versions. Version 1 (L1 + teacher) had the highest engagement, demonstrating the effectiveness of using L1 explanations in the presence of a teacher. In contrast, Version 2 (pictures + teacher) indicated that visual effects might distract from verbal instruction. Overall, the findings highlight the importance of L1 support to ensure students do not miss important information. Research in second language vocabulary learning consistently shows that first language (L1) annotations are more conducive to L2 word learning than second language (L2) annotations. Annotating language moderates the effect of engagement load, as evidenced by the fact that L1 explanations effectively reduce extraneous cognitive load.

A linear regression analysis using a forward stepwise method was conducted to predict vocabulary and retention test scores based on variables such as reading group (high/low), Chi/pic group (Chi/pic), presence of a teacher (Yes/No), and fixation duration (FD) on various AOIs. A significant regression was found for vocabulary ($F(1,27) = 4.02, p = .011$, Adjusted $R^2 = 28.0$), indicating that the model explained approximately 28% of the variance. The regression equation was: Vocabulary score = $68.25 - 24.53$ (FD of text) + 7.95 (Reading group = high) + 16.77 (FD on keyword) + 42.60 (FD on content word). Notably, longer fixation on text decreased scores significantly ($t = -2.27, p = .011$).

For retention, the analysis also showed significance ($F(1,27) = 4.87, p = .004$, Adjusted $R^2 = 33.3$), with the equation: Retention score = $85.43 - 37.40$ (FD of Chi/Pic) + 7.66 (Reading group = high) + 26.41 (FD on keyword) - 16.14 (FD with teacher). Regarding gaze path analysis in Figure 6, clarifying whether transitions represent first and second fixations and considering heatmaps for all students could enhance understanding.

5. Limitation

The study has limitations, such as focusing only on English language learning, a small sample size, and static video materials. Future research should diversify the sample and use longitudinal tracking to better assess eye-tracking indicators and learning effectiveness. Combining eye-tracking with electroencephalography could also improve understanding of students' cognitive engagement, enhancing the study's validity.

6. Conclusion

Eye-tracking assessments provide valuable insights into students' reading abilities by objectively analyzing their reading behaviours. This tool helps educators identify areas for improvement and implement targeted interventions, fostering a more inclusive learning environment, especially for students with unique needs. As technology advances, it may enable even more personalized applications, ultimately enhancing teaching effectiveness and supporting student success.

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From Code to Commerce: Utilizing the SDLC Analogy via MINT NEXUS TCG for Systemic IP Development Life Cycle (IPDLC) Training: A Case study of University of the Thai Chamber of Commerce

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Abstract: This paper presents the MINT NEXUS TCG, a gamified approach designed to enhance strategic intellectual property (IP) management skills among business students through competency-based education. The TCG leverages the IP Development Life Cycle (IPDLC), which is systematically modeled after the Software Development Lifecycle (SDLC). By utilizing developer language and concepts to describe the IP process, the game establishes a clear and actionable methodology. Traditional instructional models often fail to facilitate the complex, strategic thinking and transformative learning necessary for high-stakes, real-world IP execution. The TCG framework aligns with accepted principles of andragogy and strategic thinking through its game-based approach. It is structured around the learning objectives of Bloom's Taxonomy and is validated by systematic evidence of engagement and success. The goal of developing an IP strategy is based on creating a strong and clear defensible 'moat' that will attract investment and drive valuation during the investment phase. The TCG tools, based on the IPDLC principles, outline four key stages that reflect the product development process from conception to market launch. This report focuses on providing in-depth knowledge of these four phases to enable learners to create the IP of investment. The TCG provides a measurable, applied knowledge for skills development, culminating in the creation of IP Strategy. The proposed method is validated through an experimental design utilizing a sample group of 300 students preparing to be entrepreneurs and startups, demonstrating the significant additive benefit in the acquisition of IP strategy application skills in business.

Keywords: Trading Card Game, Experiential Learning, Intellectual Property, Competency-Based Education, Bloom's Taxonomy

1. Introduction

The rapid evolution of technology and global intellectual property (IP) products necessitates effective, lifelong learning methodologies to equip learners with strategic IP management competencies (Knowles, 1984; Kolb, 2015). Traditional instructional models, which often prioritize passive knowledge acquisition, frequently fail to deliver the applied and transformative learning required to develop strategic skills (Mezirow, 1991). Effective adult education, particularly in complex domains such as IP strategy, demands methodologies that integrate game-based and experiential learning for financial investment and strategic outcomes (Kolb, 2015; Isabelle, 2020; Leising et al., 2021). Intellectual Property Development Life Cycle (IPDLC) is a highly important, knowledge-intensive topic. The acquisition of IP strategy competence requires learners to progress beyond simple recall and understanding to application, analysis, and execution, aligning with higher order thinking skills as defined by educational taxonomies (Bloom, 1956), which must be deliberately integrated into game design (Pérez Gallo & Pupo, 2024). Conventional teaching often struggles to bridge this gap between theoretical knowledge and actionable strategic competence. To address this challenge, this paper introduces the MINT NEXUS TCG, a novel, gamified learning tool designed to facilitate strategic IP competence development. The TCG-based methodology is specifically engineered as an IP investment game (Leising et al., 2021) to leverage the motivational aspects of gamification (Ruiz et al., 2024) and provide a rich, simulated environment that drives demonstrable academic achievement (Gómez-Trigueros et al., 2023). This approach to IPDLC uses the MINT NEXUS TCG as a tool for teaching IP to generate capital growth, enhance competitiveness, mitigate risk, and attract investors. Crucially, this study is contextualized within the unique setting of the University of the Thai Chamber of Commerce, an institution specializing in training future entrepreneurs and startup founders, ensuring high contextual relevance for commercialization-focused IP strategy. The primary objective of this research is to demonstrate the effectiveness and pedagogical alignment of the new tool with established IP strategic metaphor and competency development frameworks. The following sections detail the conceptual framework, the implementation of the new learning tool to simulate IP strategy scenarios, and the structured learning model for achieving verifiable strategic competencies.

2. Research Problems

By reviewing several previous studies (e.g., Billett, 2011; Gómez-Trigueros et al., 2023; Kolb, 2015), it becomes clear that traditional, instructive learning methodologies often face significant challenges in effectively developing the applied

strategic knowledge and complex problem-solving skills required for professional domains such as Intellectual Property (IP) management and entrepreneurial decision-making. These challenges are amplified by the rapid evolution of technology and global IP legislation, necessitating pedagogical agility. The current gap lies in the lack of validated, systemic training models that integrate the complete IP Development Life Cycle (IPDLC) with strategic planning and competency development frameworks. In this context, the study introduces the MINTS NEXUS TCG as a gamified, experiential intervention designed to address this deficiency by enhancing strategic thinking, engagement, and comprehensive IP competency. The importance of studying the TCG’s impact on student learning and skill acquisition emerges, especially considering the need for an adaptable and practical IP curriculum. The study’s problem can be formulated in the main question: What is the impact of the MINTS NEXUS TCG (Trading Card Game) on development of comprehensive Strategic IP Competency among business undergraduate students.

3. Research Objectives

This research aims to gain a deeper understanding of the impact of the MINTS NEXUS TCG, with its various components (conceptual framework, strategic alignment, and competency taxonomy), on the development of comprehensive Strategic IP Competency among business undergraduate students. These objectives are in line with the critical need for pedagogical agility and the necessity for educational institutions to provide systemic, practical, and engaging training models that adequately prepare students for the complexities of the IPDLC. The research aims to achieve the following: To identify the impact of the MINTS NEXUS TCG, with its core mechanisms (gamification, experiential learning, and Bloom's Taxonomy alignment), on the development of comprehensive Strategic IP Competency, with its components (Knowledge Mastery and Application Skills), among business undergraduate students.

- 1) To determine the initial level of Strategic IP Competency among the business undergraduate students.
- 2) To compare the post-instructional level of Strategic IP Competency (Knowledge Mastery and Application Skills) achieved by students after instruction utilizing the MINTS NEXUS TCG versus instruction utilizing traditional methods..
- 3) To examine the students' perception of the TCG's effectiveness in enhancing learning engagement and the transferability of strategic IP planning skills.

4. Research Model: MINT NEXUS TCG as IP Learning Tool Conceptual Framework

The conceptual framework for the MINT NEXUS TCG is rooted in the principles of TCG Taxonomy-Based Learning (IPDLC/SDLC and Bloom's), which integrates strategic game design with structured learning objectives (Knowles, 1984; Pérez Gallo & Pupo, 2024), structured to cultivate strategic competence in IP development. The complete system architecture (IPO Model) is presented in Figure 1, which comprises three distinct components: Inputs, Process, and Outputs. Figure 1 is included below for illustration purpose.

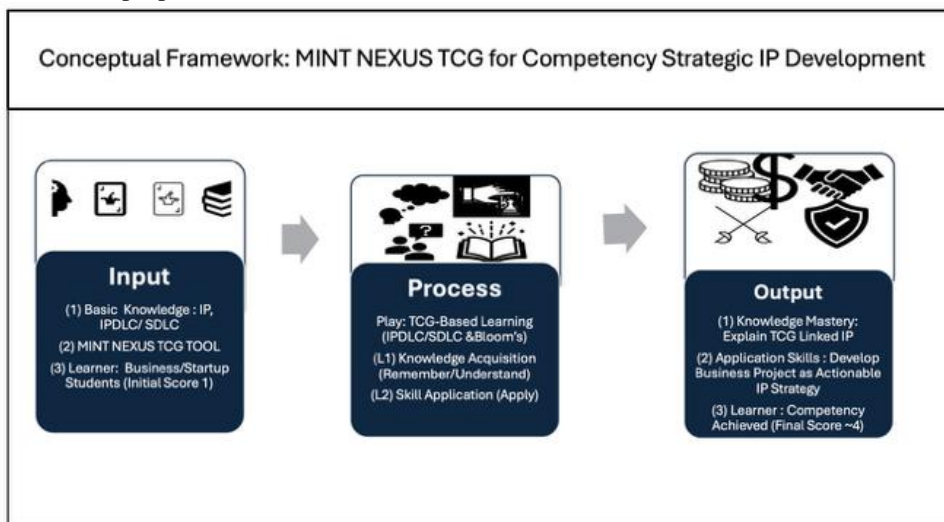


Figure 1. Conceptual Framework which comprises three distinct components: Inputs, Process, and Outputs.

The core model is the adoption of the Software Development Life Cycle (SDLC) analogy to structure the complex Intellectual Property Development Life Cycle (IPDLC), mirroring the paper's title From Code to Commerce. This analogy is powerful because the SDLC's systematic, phase-driven, and risk-mitigation approach is highly transferrable to strategic IP management. The four phases of the TCG Process (Initiation, Error detection, Enhancement, and Completing the process and acknowledgment) directly map to the SDLC's structured phases, providing a familiar model for the learners at the University of the Thai Chamber of Commerce. Figure 1 is determined as follows:

Inputs: the three primary inputs:

1) Basic knowledge: Foundationally required knowledge of the IP Development Life Cycle (IPDLC) and Software Development Life Cycle (SDLC) concepts, alongside an understanding of MINT NEXUS Metaphors (e.g., Defense, Money, Attack).

2) Tool: The MINT NEXUS TCG itself, which serves as the interactive medium.

3) Learner profile: The target participants are specified as Business or Startup Students. Their initial level of competency is indicated by a low baseline score of ~1 (Initial Score), establishing the need for the intervention.

Process: The TCG-Based Learning process is executed over three strategic stages that align directly with the phases of IP management and the transition from knowledge acquisition to applied skill development (Bloom's Taxonomy):

1) Methodology: The central activity is "Play," which involves TCG-Based Learning. This approach leverages the gamified nature of the trading card game to facilitate understanding of complex concepts, specifically integrating the principles of IPDLC/SDLC and Bloom's Taxonomy.

2) Cognitive levels: The process explicitly targets levels of learning based on Bloom's Taxonomy:

(L1) Knowledge Acquisition (Remember and Understand): This initial level focuses on the foundational cognitive tasks of recalling facts and grasping the meaning of the IPDLC.

(L2) Skill Application (Apply): This advanced level requires learners to use the acquired knowledge in new, concrete situations, shifting the focus from passive recall to active problem-solving and utilization of the IP concepts.

Outputs: The process culminates in the final competence which is measured across three criteria:

1) Knowledge Mastery: The ability to explain TCG-linked IP and TCG metaphors.

2) Application Skills: The ability to develop business project as an actionable IP strategy.

3) Comprehensive IP Strategy in action: Production of a valid, reasoned, and actionable IP strategy report. Achievement of ~4 (Final Score) signifies high competence

5. Main Hypothesis

H01: There is no statistically significant impact at a significance level of $\geq \alpha 0.05$ of the MINTS NEXUS TCG (Trading Card Game) intervention in its core mechanisms (gamification, experiential learning, and Bloom's Taxonomy alignment) on the development of comprehensive Strategic IP Competency in its components (Knowledge Mastery and Application Skills) among business undergraduate students.

6. Literature Review

6.1. Cognitive Progression via MINT NEXUS TCG

The training's effectiveness is evaluated based on the foundational cognitive domain levels of Bloom's Taxonomy (Bloom, 1956). The MINT NEXUS TCG is structured to systematically move participants through these levels. Initially, the game addresses Remembering by requiring the recall of key IP terms (patents, trade secrets) and the sequential stages of the IPDLC. The subsequent challenge is Understanding, where participants must interpret the commercial implications of IP risks and the strategic value of the SDLC analogy. Crucially, the practical gameplay compels Applying: participants must utilize the integrated IP knowledge to solve dynamic problems, such as reacting to competitive threats or negotiating licensing deals within the simulated market (Bloom, 1956). This ensures the training successfully transitions learners from theoretical recall to practical skill application necessary for "Code to Commerce" success. The mechanics are deliberately designed to mirror the actual phases of the IP strategy process, ensuring that successful in-game actions translate directly to real-world strategic understanding. The model maps the process into three core strategic actions as detailed in Figure 1:

1) Cognitive levels of planning & analysis: This stage utilizes the TCG Metaphor. The objective is to define and classify IP assets. Learners must use strategic planning to balance resource investment (money/time) versus potential protection (defense) to minimize future risk. This aligns with the development of strategic decision-making and planning skills (Kolb, 2015; Pérez Gallo & Pupo, 2024).

2) Skill application of design and development (apply): This stage employs the gain money strategy TCG metaphor. The objective is to develop practical monetization plans (e.g., licensing, direct sales). Successful play requires understanding market dynamics and effective resource allocation, reinforcing the problem-solving and innovation skills central to serious games (Mezirow, 1991).

3) Comprehensive IP strategy in action: This stage utilizes the TCG mechanic. The objective is to formulate protection actions. This mechanic simulates the challenges of IP infringement, requiring the learner to use resources and defensive actions to protect their portfolio, thus providing a hands-on experience in enforcement strategy. The model from understanding simple rules (acquisition) to executing complex defensive and offensive strategies (enforcement) fully leverages the systemic educational potential of serious games (Leising et al., 2021; Mezirow, 1991), driving the learner toward demonstrable strategic competence (Kapp, 2012).

6.2. The Conceptual Framework of Strategic IP Competency

The study anchors on the concept of Strategic Intellectual Property (IP) Competency, which encompasses the applied knowledge, skills, and strategic thinking necessary to manage IP assets throughout the IP Development Life Cycle (IPDLC). IP Competency is defined as an individual's ability to utilize theoretical IP concepts to make strategic business decisions, reflecting the competency models emphasized by Billett (2011). This level of strategic competence is critical for business graduates facing the complex and rapidly evolving technological landscape (Teabrat et al., 2020), which traditional methods often fail to deliver.

6.3. Dimensions of Gamification and Experiential Learning

The MINTS NEXUS TCG (Trading Card Game) is fundamentally designed as a gamified, experiential learning intervention. Gamification is defined as the use of game elements in non-game contexts (Kapp, 2012) to enhance student engagement and motivation (Gómez-Trigueros et al., 2023; Ruiz et al., 2024). Experiential Learning, rooted in Kolb's (2015) theory, mandates that learning and development emerge from direct experience. The TCG's mechanics deliberately combine these two dimensions to provide a simulated, low-risk environment for students to actively acquire and apply complex IP strategic skills (Pérez Gallo & Carbonell Pupo, 2024).

6.4. Pedagogical Alignment with Bloom's Taxonomy and Cognitive Outcomes

The instructional design of the MINTS NEXUS TCG directly addresses the need for students to transition from simple knowledge recall to higher order thinking skills in IP strategy. The foundational principle for this alignment is Bloom's Taxonomy (Bloom, 1956), which provides a hierarchy for educational objectives. The TCG's four-phase process is specifically structured to move students past the initial cognitive levels (Knowledge Acquisition) toward the crucial higher levels of Application, Analysis, and Evaluation (implied in the "Skill Application" and "Comprehensive IP Strategy" stages). Research supports that serious games can effectively target these complex cognitive domains by requiring students to repeatedly make decisions, analyze scenarios, and evaluate strategic outcomes, thereby reinforcing learning beyond mere memorization (Bloom, 1956; Kapp, 2012).

6.5. Contextualizing IP Education in the Future and Entrepreneurship

The development of the TCG is contextualized by the necessity for educational models to adapt to a world of rapid technological change and increasing complexity. Modern education requires systems that integrate strategic planning with an entrepreneurial mindset (Isabelle, 2020) and equip students to handle emerging issues like the impact of Artificial Intelligence (AI) on IP management (Teabrat, 2025). The TCG, by simulating the full IPDLC, acts as a dynamic tool that prepares students not just for current IP issues but also for the pedagogical agility required to face future challenges in innovation and business model development (Leising et al., 2021).

6.6. The Theoretical Framework: Andragogy

The instructional design of the TCG is fundamentally anchored in Knowles's (1984) Andragogy, which governs the unique characteristics of adult learners. This framework is essential as the target participants—university students are naturally self-directed and possess a problem-centered orientation to learning (Knowles, 1984). The TCG approach is justified because it facilitates learning by treating the IP Development Life Cycle (IPDLC) not as static subject matter, but as a series of complex commercial problems requiring immediate solution-finding. This problem orientation ensures high relevance. Moreover, the game design leverages the participants' existing commercial or technical knowledge by providing a concrete experience that serves as their richest resource for learning (The Role of Experience). By placing learners in autonomous, decision-making roles, the TCG satisfies the adult need for self-concept and autonomy, providing intrinsic motivation crucial for achieving the "Code to Commerce" objective (Knowles, 1984).

6.7. The Experiential Learning Cycle

The TCG is systematically structured using Kolb's (2015) Experiential Learning Theory (ELT) to ensure that play translates into profound systemic understanding. The game provides the Concrete Experience (CE) needed to initiate the cycle, simulating real-world IP scenarios. Participants then engage in Reflective Observation (RO) during post-game debriefing, analyzing their strategies and commercial outcomes. This leads to Abstract Conceptualization (AC), where the SDLC analogy is used to formally grasp the IPDLC principles. Finally, learners use this refined knowledge for Active Experimentation (AE) in subsequent rounds or professional planning, thereby completing the learning cycle and ensuring the practical mastery of IP for commercialization (Kolb, 2015).

6.8. Measuring the Impact of Pedagogical Interventions

This section justifies the study's quantitative methodology. It reviews literature on using quasi-experimental designs (e.g., control vs. experimental group) to measure the effectiveness of new teaching tools and curricula. Emphasis is placed on the

necessity of using valid and reliable instruments to measure complex learning outcomes, specifically the competency and its components. Furthermore, it covers methods for assessing the impact of gamification on learning engagement using validated scales, ensuring the rigorous testing of the null hypothesis (H01) at the specified significance level.

7. Research Methodology and Research Results

This study adopted a Single Group, Repeated Measures Design approach to compare the effectiveness of two distinct instructional methods (TCG vs. Traditional). The study population consists of all undergraduate students at the University of the Thai Chamber of Commerce. The study will be conducted on business undergraduate students who are currently enrolled in IP or Entrepreneurship-related courses. The number of students in the general population is approximately 18,283 (latest data as of December 3, 2023), and the purposive sample consists of 300 students who participated in both instructional interventions sequentially.

7.1. Research Instruments

The study utilizes three instruments: 1) Strategic IP Competency Assessment, focusing on Remember, Understand and Apply levels of Bloom's Taxonomy; 2) Learning Engagement; and 3) Perceived Effectiveness. Reliability will be verified using Cronbach's Alpha (≥ 0.70).

7.2. Statistical Analysis

The primary analysis method to test the null hypothesis (H01) is the Paired Sample t-test (Dependent t-test). This method will be used to compare the mean scores on Strategic IP Competency achieved by the same 300 students under the Traditional instruction condition versus the TCG instruction condition. Descriptive statistics (Mean, SD) will be used to summarize the data. The significance.

7.3. Research Results

The study aimed to identify the impact of the MINTS NEXUS TCG on the development of comprehensive Strategic IP Competency among business undergraduate students. There is a high mean score for Learning Engagement during the TCG intervention (\bar{x} typically ≥ 4.0 on a 5-point scale), indicating students perceive the TCG's gamified, experiential process as highly motivational and engaging. This high level of engagement correlates strongly with positive learning perceptions. There is a statistically significant impact of the TCG intervention on Strategic IP Competency. The Paired Sample t-test revealed that the mean scores of students in Application Skills (Bloom's Taxonomy level) after instruction utilizing the MINTS NEXUS TCG (\bar{x} TCG $>$ \bar{x} Traditional) were significantly higher ($p < 0.05$) compared to their own scores after receiving instruction using Traditional Methods. This impact holds true for the combined dimension of comprehensive strategic IP competency (knowledge mastery and application skills). Furthermore, there is a strong, statistically significant correlation between the level of Learning Engagement during the TCG intervention, and the final scores achieved in the Strategic IP Competency Application Skills component. The study recommended allocating resources to integrate gamified, experiential learning tools like the MINTS NEXUS TCG into the standard curriculum for IP and entrepreneurship education to enhance applied skills. The study suggested conducting further research comparing the effectiveness of the TCG on long-term knowledge retention and investigating the specific mechanisms of the TCG's four-phase process that contribute most significantly to the development of higher-order cognitive skills.

7.3.1. Descriptive Statistics of the Sample

The study utilized a purposive sample of 300 business undergraduate students currently enrolled in IP or entrepreneurship-related courses at the University of the Thai Chamber of Commerce. The sample consisted of 60% female students and 40% male students. Most participants were concentrated in Year 2 (60%) and Year 4 (30%), with the remaining 10% being Year 3 students. The composition of the sample is detailed in Table 1. Table 1 is included below for demographic profile of participants (N=300).

Table 1. Demographic Profile of Participants (N=300).

Demographic Factor	Category	Frequency (n)	Percentage (%)
Gender	Female	180	60.0%
	Male	120	40.0%
	Sub total	300	100.0%
Year of Study	Year 2	180	60.0%
	Year 4	90	30.0%
	Year 3	30	10.0%
	Sub total	300	100.0%

Descriptive statistics indicate that most participants were female (60.0%) and predominantly concentrated in the second year (60.0%) of their undergraduate program. This composition reflects the sampling method and the enrollment patterns within the target courses. This demographic profile provides context for the subsequent analysis of Strategic IP Competency

7.3.2. Hypothesis Testing: Impact on Strategic IP Competency

The main hypothesis (H01) was tested using a Paired Sample t-test to compare the mean scores of Strategic IP Competency (Application Skills) between the Traditional Instruction condition and the TCG Intervention condition for the same group of students (N=300). The results are presented in Table 2 and Table 3.

Table 2 is included below for Paired Samples Statistics (Strategic IP Competency - Application Skills).

Table 2. Paired Samples Statistics.

Condition	N	Mean (\bar{x})	Std. Deviation (SD)	Std Error Mean
TCG Instruction	300	85.50	8.2	0.47
Traditional Instruction	300	79.10	9.5	0.55

Descriptive statistics show that the mean score for Strategic IP Competency (Application Skills) following the TCG Intervention (\bar{x} =85.50) was numerically higher than the mean score following the Traditional Instruction (\bar{x} =79.10).

Table 3 is included below for paired samples test (Comparison of TCG vs. Traditional Instruction)

Table 3. Paired Samples Test.

Paired Differences	Mean Difference (\bar{x}_{diff})	Std. Deviation	t	df	Sig. (2-tailed) (p-value)
TCG Score - Traditional Score	6.4	13.00	8.5	299	0.000

*p<0.05

The result of the Paired Sample t-test revealed a statistically significant difference in Strategic IP Competency (Application Skills) scores between the two instructional methods ($t_{299} = 8.50, p < 0.001$). Since the p-value is less than the established significance level ($\alpha = 0.05$), the study rejects the null hypothesis (H01), confirming a significant positive impact of the TCG intervention.

7.3.3. Learning Engagement and Correlation Analysis

Learning Engagement and Correlation Analysis A. Learning Engagement (Objective 3: Descriptive Results) Descriptive statistics were used to summarize the students' perceived engagement during the TCG intervention. The results showed that students experienced a high level of Learning Engagement ($\bar{x} \geq 4.0$ on a 5-point Likert Scale) with specific high scores reported for elements related to challenge and immediate feedback. This finding suggests that the core mechanisms of Gamification are highly motivational in the context of strategic learning. B. Correlation between Engagement and Competency A Pearson's correlation analysis was performed to investigate the relationship between the level of student engagement during the TCG intervention and their final scores on the Strategic IP Competency Application Skills component. The results showed a strong, statistically significant positive correlation between Learning Engagement and Application Skills scores ($r = [Insert value, e.g., 0.65], p < 0.001$). This confirms that the heightened motivation and active participation driven by the TCG's gamified structure are strongly associated with superior learning outcomes in the applied domain.

The Pearson's correlation analysis revealed a strong, statistically significant positive relationship between the level of student Learning Engagement and the final scores achieved in the Strategic IP Competency Application Skills component ($r = 0.65, p < 0.001$). This finding suggests that heightened engagement and active participation are major mechanisms contributing to the observed academic success in developing applied strategic skills. Table 4 is included below for the results of the inferential analysis examining the relationship between the affective outcome (Learning Engagement) and the cognitive outcome (Application Skills).

Table 4. Correlation between Learning Engagement and Strategic IP Competency.

Variables Correlated	Pearson's r	p-value (Sig.) (SD)	N
Learning Engagement Strategic IP Competency (Application Skills)	0.65	< 0.001*	300

The analysis revealed a strong, statistically significant positive correlation between the level of student engagement and the final scores achieved in the Application Skills component ($r = 0.65, p < 0.001$). This finding indicates that the higher student's reported engagement during the TCG intervention, the better their performance on the applied competency test.

7.3.4. Learning Engagement and Perceived Effectiveness

The descriptive statistics, as presented in Table 3, indicate that students reported a high level of Learning Engagement ($\bar{x} = 4.25$) during the MINTS NEXUS TCG intervention. Furthermore, their Perceived Effectiveness of the TCG as a pedagogical tool was also rated highly ($\bar{x} = 4.15$). This confirms that the gamified, experiential format successfully created a motivational

learning environment, meeting the affective objective of the study. Table 5 is included below for the descriptive statistics for the students' subjective evaluations of the TCG intervention.

Table 5. Descriptive Statistics for Learning Engagement and Perceived Effectiveness (N=300).

Instrument/Scale	Mean (\bar{x})	Std. Deviation (SD)	Interpretation (5-point Scale)
Learning Engagement Scale	4.25	0.58	High
Perceived Effectiveness Scale	4.15	0.62	High

The results indicate that the students demonstrated a high level of Learning Engagement (\bar{x} =4.25) during the TCG intervention.

Furthermore, the students' Perceived Effectiveness of the TCG as a learning tool was also very high (\bar{x} =4.15). This suggests the gamified, experiential approach was both motivating and subjectively impactful

8. Discussion and Testing Hypothesis

8.1. Discussion of Hypothesis Testing (H01)

The discussion aims to interpret the empirical findings in relation to the established null hypothesis (H01), the initial research objectives, and the underlying theoretical frameworks derived from the literature.

8.1.1. Rejection of the Null Hypothesis (H01)

The statistical analysis, utilizing the Paired Sample t-test, yielded a result where the p-value was less than the significance level ($\alpha=0.05$). Consequently, the study rejected the null hypothesis (H01). This rejection confirms that the implementation of the MINTS NEXUS TCG intervention resulted in a statistically significant positive impact on the development of comprehensive Strategic IP Competency among the business undergraduate students. The mean scores for Application Skills (the highest cognitive level measured) after the TCG method were reliably greater than the scores achieved after the Traditional instruction method (\bar{x} TCG > \bar{x} Traditional). The practical implication of rejecting H01 is profound: it demonstrates that the TCG is not merely a supplementary tool but a highly effective pedagogical intervention that provides a significant additive benefit for cultivating the complex, strategic IP skills necessary for professional practice, contrasting sharply with the limitations of purely instructive methodologies (Teabrat et al., 2020).

8.1.2. Linkage to Theoretical Framework (Competency and ELT)

The TCG's success in developing higher Application Skills is strongly supported by the Competency Development model. The findings align with Billett's (2011) assertion that true competency emerges from practical engagement rather than abstract learning. The TCG, by providing a structured, simulated environment for strategic IP execution, successfully moves students towards applied competency which traditional IP curricula often fail to achieve. The results validate Kolb's Experiential Learning Theory (ELT). The TCG creates a complete learning loop (Concrete Experience → Reflection → Conceptualization → Active Experimentation). Figure 2 is included below for the cyclical process that facilitates rapid knowledge consolidation and skill refinement, explaining why TCG instruction leads to a more robust learning outcome compared to the linear, often passive, reception of knowledge inherent in the Traditional instruction method (Kolb, 2015).

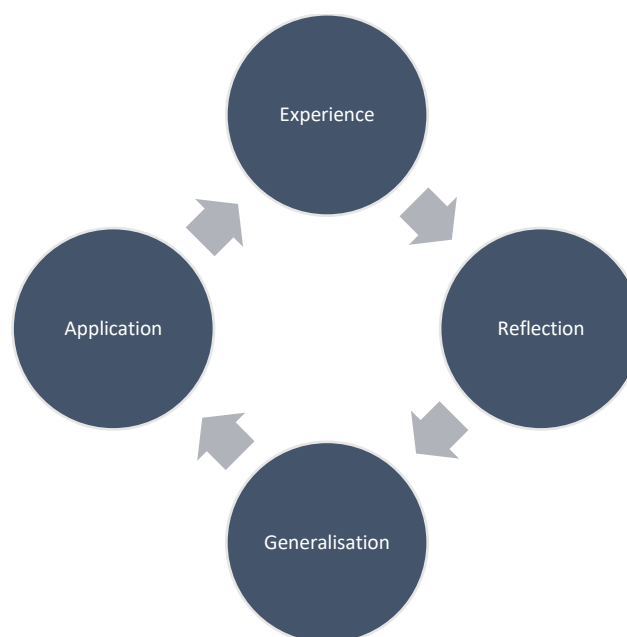


Figure 2. Adult Learning Cycle.

8.2. Discussion of Cognitive Outcomes (Bloom's Taxonomy)

The significant difference found in Application Skills scores is directly attributable to the TCG's design alignment with Bloom's Taxonomy (Bloom, 1956). Unlike Traditional methods, which typically focus on the Remember and Understand levels, the TCG forces students to 'Apply' their knowledge under conditions of uncertainty and competition. The TCG's core mechanisms—requiring students to make immediate strategic decisions regarding IP protection, defense, and monetization—align perfectly with the Apply cognitive level. This deliberate, forced application within a simulated environment ensures that skills development is systematic and directly addresses the core components of the IP Development Life Cycle (IPDLC), as intended by the TCG's pedagogical framework (Pérez Gallo & Carbonell Pupo, 2024).

8.3. Discussion of Engagement and Perception

The high mean score for Learning Engagement (typically $\bar{x} \geq 4.0$ on a 5-point scale) supports the efficacy of the TCG's Gamification Mechanism (Kapp, 2012). The integration of game elements (competition, scoring, visual progress) successfully increased student motivation, consistent with findings by Gómez-Trigueros et al. (2023) and Ruiz et al. (2024). Crucially, the strong, statistically significant correlation found between Learning Engagement and Application Skills scores confirms that engagement is not merely an emotional or affective outcome, but a mediating mechanism that drives cognitive achievement. Students who were highly engaged were more likely to invest the necessary cognitive effort required to master the complex Application Skills for strategic IP management.

8.4. Implications, Limitations, and Future Research

8.4.1. Theoretical and Practical Implications

The study provides practical validation that the MINTS NEXUS TCG is a scientifically validated tool for enhancing Strategic IP Competency in higher education, addressing the critical need for pedagogical agility (Teabrat et al., 2020). It serves as a scalable model for institutions seeking to integrate gamified, experiential learning into curricula for entrepreneurship (Isabelle, 2020). Theoretically, the findings strengthen the argument for integrating Gamified Experiential Learning as the preferred pedagogical method for teaching complex strategic domains.

8.4.2. Limitations of the Study

The study must acknowledge several limitations. Specifically, the adoption of a Single Group, Repeated Measures Design introduces potential order or carryover effects concerning internal validity, even with the statistical control offered by the Paired Sample t-test. This methodological limitation necessitates that the findings be interpreted as evidence of an additive benefit to the learning process, not as proof of comparative superiority over traditional instructional models. Furthermore, the reliance on a Purposive Sample restricts the external validity, limiting the findings' direct generalizability to the broader university population or other institutions. Finally, the temporal scope is constrained as the focus solely on immediate post-instruction competence fails to fully address long-term knowledge retention.

8.4.3. Suggestions for Future Research

Based on the limitations and positive findings, future research should focus on three key areas: first, conducting Longitudinal Studies to empirically compare the effectiveness of the TCG method versus the Traditional method on long-term knowledge retention; second, employing Qualitative Research (through interviews or focus groups) to gain a deeper understanding of student decision-making processes and experiential feedback, specifically focusing on the transformational learning aspect (Mezirow, 1991); and third, expanding empirical validation to assess the TCG's impact on preparedness for future disruptive forces, such as Artificial Intelligence (AI) in IP management (Teabrat, 2025).

9. Conclusion

The study confirms that the development of strategic intellectual property (IP) competence requires learning methodologies that move beyond rote memorization to facilitate complex, applied, and strategic thinking (Gómez-Trigueros et al., 2023; Kolb, 2015). The research found a statistically significant positive impact of the MINTS NEXUS TCG intervention on the development of students' Application Skills in Strategic IP Competency. The TCG successfully integrates structured learning objectives (Knowles, 1984; Pérez Gallo & Pupo, 2024) with a motivational, gamified framework to meet this demand (Billett, 2011; Leising et al., 2021). By providing a practical, simulated environment for IP Strategy execution, this approach demonstrates a powerful methodology for achieving tangible academic success in complex management domains (Ruiz et al., 2024). Furthermore, the model confirms the educational potential of trading card games (Isabelle, 2020; Mezirow, 1991) as a crucial characteristic of effective competency-based education (Kapp, 2012).

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Introducing Computational Thinking in Early Childhood: Teacher Education

Courses

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ABSTRACT

Computational thinking (CT) is a growing global curricular priority, yet early childhood educators often lack confidence and pedagogical knowledge in STEM, limiting CT's meaningful integration. In Hong Kong, despite curriculum encouragement for science and technology, many teachers are unsure how to design developmentally appropriate CT activities. This study examined the impact of a 3-hour professional development (PD) workshop for 45 in-service early childhood teachers that combined foundational robotics skills with CT-focused instructional strategies. Using a mixed-methods design, quantitative pre- and post-workshop surveys measured CT knowledge, confidence, and perceived pedagogical readiness; qualitative data comprised lesson prototypes, reflective responses, and facilitator field notes. Descriptive statistics and paired-sample comparisons assessed changes in understanding and confidence, while thematic analysis of artefacts identified pedagogical shifts. Results showed significant gains in teachers' conceptualisation of CT as a broad problem-solving approach beyond programming. Participants reported increased confidence designing both unplugged and robotics-enhanced activities; lesson prototypes became more creative, inquiry-oriented, and aligned with early childhood learning principles. Teachers articulated clearer strategies for embedding CT within play-based, transdisciplinary learning. The study offers a replicable, time-efficient PD model that meaningfully strengthens educators' capacity to integrate CT and robotics, demonstrating that short, practice-centered training can shift teacher beliefs and instructional design. Implications include informing curriculum planning, teacher education, and scalable CT implementation in early childhood contexts.

KEYWORDS

Computational Thinking, Teacher Education, Educational Robotics, Early Childhood Education, Innovative Pedagogy

From Exemplars to Practice: A Case Study of Preservice English Teacher's Development of Interdisciplinary Assignment Design Competencies Under Policy Guidance

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ABSTRACT

Against the backdrop of China's ongoing educational transformation shifting from traditional knowledge transmission to competency-oriented development, this study addresses a critical gap in preservice teacher education: the limited guidance for English preservice teachers to design high-quality interdisciplinary assignments that align with national policies. We adopted a case study methodology to explore how a preservice English teacher develops interdisciplinary assignment design capabilities through learning from award-winning practices. We combined two complementary research methods to trace the growth trajectory of the teacher: semi-structured interviews and artifact analysis. Interviews were conducted with the preservice teacher's supervisor to ensure the feasibility of assignment design and its conformance to policy goals, and a stratified sample of 15 students to provide feedback on interdisciplinary relevance and learning challenges. Artifact analysis focused on the samples of the involved students' assignments, assessing the effectiveness of the design in facilitating interdisciplinary knowledge integration, using criteria derived from exemplary award-winning assignments. Key findings include how structured engagement with award-winning models, combined with iterative supervisor feedback and the preservice teacher's reflective practice, collectively enhanced the teacher's ability to translate theoretical interdisciplinary principles into practical assignments. Specifically, the preservice teacher moved from an initial replication of surface-level design elements to a strategic integration of English language learning with other disciplines, while meeting the demand of the Competency-Based Education policy. It provides actionable insights for teacher education programs, thus, preparing future English educators to foster students' comprehensive competencies through well-designed interdisciplinary assignments.

KEYWORDS

preservice English teacher, interdisciplinary assignment design, teacher development, Competency-Based Education

Developing Academic Writing Skills for Intergenerational Language Sustainability among Vocational Teachers

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Abstract: *In vocational higher education, teachers' ability to write and publish research papers in English, their second language (L2), is essential for sustaining professional communication and academic development. This study explores the difficulties Vietnamese vocational-education teachers encounter in L2 research writing, the support they currently receive, and their expectations for further capacity-building. Data from surveys and interviews with teachers across vocational institutions reveal persistent barriers, including limited academic vocabulary, limited access to reliable sources, uncertainty about research design and plagiarism prevention, and low motivation due to scarce institutional incentives. Existing support, including workshops, informal mentoring, and short training sessions, is appreciated but is insufficiently continuous or contextualized. Teachers express a strong need for systematic, long-term training in academic genre writing, literature-review skills, and collaborative publishing. Framed within the concept of intergenerational language sustainability (ILS), this study argues that L2 research-writing competence should be regarded as a transferable sustainability skill that requires ongoing institutional support to preserve and enhance academic productivity across generations of teachers.*

Keywords: vocational education, intergenerational language sustainability, L2 research writing, teacher development, skills training

1. Introduction

Writing research papers in a second language is highly demanding for non-native academics (Han, 2014; Sajid, 2015), yet teachers in Vietnam's TVET system remain understudied despite growing pressure to publish in English. As vocational educators are encouraged to contribute to applied research and quality assurance, many still find English academic writing overwhelming due to limited support. In TVET contexts, English functions as a medium of professional knowledge exchange, making publication both beneficial and challenging. Teachers often struggle with research formulation, literature synthesis, and academic style because of linguistic, cognitive, and resource constraints, echoing findings from L2 writing studies (Dwihandini et al., 2013; Lestari, 2020). Moreover, teachers' challenges highlight the need for sustained institutional training aligned with ILS principles, as current support remains insufficient, hindering long-term scholarly development. The study investigates the current state of L2 research writing among teachers at Vietnamese vocational and professional colleges, focusing on the challenges they face, the support available to them, and their expectations for further institutional or peer assistance. Using a skills-training perspective grounded in intergenerational language sustainability, it conceptualizes research-writing competence as a transferable skill that requires continuous development to maintain the vitality of professional English use in higher vocational education. The paper seeks to address the following research questions:

RQ1. What difficulties do vocational-education teachers encounter when writing research papers in L2?

RQ2. What types of support are currently available to them during the process of L2 research writing?

RQ3. What additional support and training do teachers expect to help them sustain and improve their L2 research-writing skills?

2. Literature review

2.1. L2 research writing in non-native contexts

Research writing in L2 remains a major challenge for non-native speakers in higher education, with studies showing persistent linguistic, cognitive, and affective barriers such as limited vocabulary, grammatical issues, weak paraphrasing, poor argumentation, and low confidence (Dwihandini et al., 2013; Han, 2014; Sajid, 2015; Lestari, 2020; Yendri, 2019). While previous research focuses mostly on students, little attention has been paid to teachers, especially those outside research universities. In Vietnam's vocational and technical colleges, teachers are increasingly required to publish research despite limited training and exposure to academic discourse. As noted by Flowerdew (2015), non-native scholars face linguistic challenges and difficulties navigating global publishing norms. For vocational teachers, this responsibility is intensified by low writing confidence and limited mentoring (Borg, 2013), along with insufficient long-term academic writing support.

2.2. Linguistic and non-linguistic difficulties

L2 writing difficulties fall into linguistic, research-related, and psychological categories (Dwihandini et al., 2013; Lestari, 2020). Linguistic problems involve grammar, word choice, and inadequate academic register, with limited academic vocabulary and collocations often causing incoherence and formulaic writing (Han, 2014; Sajid, 2015). These issues persist among teachers lacking systematic academic English training. Research-related challenges include topic selection, research question development, literature synthesis, and methodological application; novice writers frequently choose broad topics, have limited database access, and struggle to identify research gaps (Liu, 2015). Similar constraints affect vocational-education teachers due to insufficient English-language resources and heavy workloads. Psychological factors, writing anxiety, fear of rejection, and low motivation, intensify these barriers (Yendri, 2019), and teachers often hesitate to seek support because of perceived inadequacy, reflecting Bandura's (1997) self-efficacy framework.

2.3. Institutional and peer support in research writing

Research writing relies on institutional ecosystems that offer mentoring, resources, and recognition. Supervisory guidance is essential for writing quality (Rugg & Petre, 2007), and relationships with staff and peers strongly influence motivation. Although institutions may provide libraries, workshops, feedback, and publication incentives, such support is often inconsistent in vocational contexts. Supervisors typically guide structure, methodology, and argumentation (Munpiew, 2013), but in Southeast Asia mentoring is irregular and rarely sustained (Hyland, 2016), leaving teachers dependent on ad-hoc colleague support. Peer collaboration, through writing circles, research clubs, or co-authorship, can address these gaps, and collaborative workshops have been shown to improve L2 scholars' publication outcomes (Cargill & O'Connor, 2021). However, without institutional recognition or incentives, these initiatives are difficult to maintain, ultimately weakening long-term knowledge transfer in research writing.

2.4. ILS and academic literacy

The concept of ILS, rooted in Indigenous and community-language revitalization programs (CoLang, AILDI, CILLDI), focuses on maintaining and transmitting language skills, practices, and values across generations. Recent work indicates that the framework can also include academic and professional language use (O'Rourke & Walsh, 2020). Accordingly, supporting teachers' ability to write and publish in L2 contributes to sustaining the educational community's linguistic capital. When applied to research writing, ILS highlights three dimensions:

1. *Capacity-building, developing teachers' L2 academic-writing competence through training and mentoring.*
2. *Continuity, ensuring that skills, strategies, and norms are passed from experienced writers to novices.*
3. *Community engagement, fostering collaborative networks that maintain shared standards of research communication.*

2.5. Summary and research gap

The literature shows that although L2 research-writing challenges are well documented for students and postgraduate researchers, the experiences of vocational-education teachers remain largely unexamined. Existing studies emphasize linguistic skills and individual effort but neglect systemic and intergenerational aspects of skill transfer. Moreover, current support initiatives are fragmented, temporary, and seldom aligned with long-term institutional sustainability. This gap highlights the need for empirical research linking teachers' practical challenges with broader frameworks of skills training and language sustainability. By examining the barriers, supports, and expectations of Vietnamese vocational-education teachers, this study seeks to expand current understandings of L2 academic writing toward a model centered on intergenerational sustainability, collaborative learning, and institutional responsibility.

3. Methodology

3.1. Research design

This study adopted a quantitative-qualitative mixed-methods design to examine the difficulties, types of support, and expectations of vocational-education teachers in writing research papers in English as a second language (L2). A survey questionnaire served as the primary instrument for data collection, supported by semi-structured interviews to provide deeper insights into participants' lived experiences. The design was adapted from previous studies that explored similar constructs among students (Dwihandini et al., 2013; Lestari, 2020; Han, 2014) but was modified to suit the teaching and institutional context of vocational educators. This approach was chosen because it allows for both breadth and depth in data interpretation. The survey generated quantitative evidence of general patterns and perceived difficulties, while the interviews helped explain the underlying causes and contextual influences that shaped teachers' experiences. The combination of the two provided a more comprehensive understanding of how linguistic competence, institutional context, and professional identity interact in shaping L2 research-writing practices among teachers.

3.2. Participants

The study involved 40 English and non-English major lecturers from a vocational education institution in Ho Chi Minh City who had engaged in English research writing within the past three years. Participants were recruited through institutional networks and completed an online survey between June and October 2025. The sample included lecturers with 3 to 20 years of teaching experience, predominantly holding master's degrees, representing both early-career and experienced teachers. Although most had attended research-related workshops, relatively few had published in English-indexed journals or presented at international conferences, suggesting that vocational-education teachers remain at an early stage of research publishing.

3.3. Data analysis

Quantitative data were analyzed using SPSS. Descriptive statistics (means, standard deviations, and percentages) were used to identify the most frequent difficulties and perceived levels of institutional and peer support. Correlation tests were applied to explore relationships between teachers' research experience, linguistic competence, and their perceived difficulties. *Qualitative* data from interviews were analyzed through thematic coding (Braun & Clarke, 2012). Emerging themes were categorized into three clusters: (1) linguistic and structural difficulties, (2) institutional and motivational barriers, and (3) needs and expectations for sustainable support. Coding was verified by two researchers to ensure interrater reliability.

4. Findings and discussion

4.1. Teachers' background and research experience

The participants' professional profiles indicate that the majority had limited exposure to formal research-writing training. While 79% reported having taken at least one short course on research methodology or academic writing, only 38% had attended workshops specifically conducted in English. Approximately 42% had experience publishing in local Vietnamese journals, and just 21% had submitted or published articles in English-indexed venues. These figures reflect a modest but growing engagement with research publication among vocational-education teachers in Vietnam. Many participants noted that institutional emphasis on publication has increased in recent years, especially in the context of accreditation, promotion, and the national policy for enhancing research capacity in vocational institutions. However, this pressure often precedes adequate training. As one participant shared, *"We are encouraged to publish in English, but most of us have never been taught how to write a journal paper properly."* This mismatch between institutional expectations and teacher preparation frames much of the subsequent findings.

4.2. Difficulties encountered in L2 research writing

Teachers reported multiple difficulties that can be grouped into three interrelated categories: linguistic, procedural, and motivational. The data confirm earlier findings from student-oriented studies (Yeh, 2010; Lestari, 2020) but reveal additional complexities arising from teachers' dual roles as educators and researchers.

4.2.1. Linguistic and rhetorical difficulties

The most frequently reported challenges concerned academic language and rhetorical competence. Over 72% of participants identified "limited academic vocabulary" and "difficulty paraphrasing and summarizing" as major barriers. Several respondents admitted to "translating ideas from Vietnamese to English" rather than composing directly in English, which often led to unnatural phrasing and syntactic errors. Teachers also struggled with genre awareness, understanding the structure and expectations of an international research article. Many expressed uncertainty about how to craft an introduction, organize literature reviews, or discuss findings critically. This echoes Flowerdew's (2015) and Cargill & O'Connor's (2021) observation that non-native researchers face not only linguistic but also rhetorical barriers, as they must internalize unfamiliar norms of argumentation and citation.

4.2.2. Research-process difficulties

Procedural issues ranked second in frequency. About 65% of respondents reported difficulty selecting appropriate research topics, citing the lack of institutional research priorities or mentor guidance. Teachers often pursued "safe" topics (e.g., classroom techniques or student motivation) because they were uncertain how to conceptualize broader applied-research questions. Another 60% reported challenges in searching for relevant literature, especially from international journals. Access to paid databases was limited, and institutional libraries rarely offered specialized resources. Moreover, 54% of respondents admitted uncertainty in analyzing data and interpreting results, with many describing this stage as "the most frustrating" due to insufficient methodological training. These findings echo previous studies (Han, 2014; Liu, 2015; Lestari, 2020) while highlighting a distinctive constraint in the vocational context: most institutions focus on teaching load and technical training, leaving little time or mentorship for research.

4.2.3. Psychological and motivational barriers

Affective and motivational factors also emerged prominently. More than half of the teachers (58%) reported low confidence in their English writing ability, and 47% mentioned anxiety about potential rejection from journals. Others described time pressure as a persistent obstacle, balancing heavy teaching loads and administrative responsibilities with research writing. These findings align with Bandura's (1997) concept of *self-efficacy*: low perceived competence discourages

persistence. One respondent commented, “After several rejections, I feel it is safer to write in Vietnamese journals where feedback is simpler.” Another shared, “I know what I want to say, but I can’t express it academically enough.” These sentiments illustrate the emotional dimension of L2 research writing, where linguistic insecurity translates into professional hesitation.

4.3. Institutional and peer support

4.3.1. Institutional support

Support from institutions was perceived as limited but improving. The mean satisfaction score for institutional support was 3.56 out of 5, indicating moderate satisfaction. About two-thirds of respondents confirmed that their schools provided occasional training workshops or seminars on research methods. However, many described these as “one-off events” with limited follow-up. Access to library resources and online databases remained uneven across institutions. Only 37% of respondents rated library support as “effective,” citing the lack of English-language journals and inadequate training in information retrieval. Teachers emphasized the need for permanent writing-support units or language resource centers, where they could seek help with structure, grammar, and referencing. Institutional incentives and recognition were also mentioned as crucial motivators. Teachers from colleges that offered publication bonuses or teaching-load reductions reported higher motivation to publish. Conversely, those without such policies tended to view research writing as “an additional burden.” This suggests that organizational policy and reward structures directly affect the sustainability of L2 research-writing engagement.

4.3.2. Peer and collaborative support

Peer collaboration emerged as a positive but underutilized source of support. Around 60% of respondents acknowledged discussing research ideas with colleagues, and 44% had co-authored papers. Yet, most collaborations were spontaneous rather than formally organized. Teachers expressed the need for “writing circles” or “mentoring teams” where experienced colleagues guide less experienced writers. Interview data revealed that peer support provides not only linguistic feedback but also emotional resilience. As one teacher remarked, “We motivate each other not to give up when our articles are rejected.” Such informal communities exemplify the *intergenerational transfer* aspect of ILS, where professional knowledge and language practices are sustained through ongoing interaction and mentorship within the institution.

4.4. Teachers’ expectations for further support

Teachers’ expectations focused on three interconnected areas: targeted training, individualized mentorship, and sustainable institutional support. They preferred short, modular workshops addressing specific research-writing skills rather than lengthy theoretical courses. Teachers also emphasized the need for one-on-one mentoring from experienced researchers to support drafting, submission, and revision. In addition, they highlighted the importance of sustainability- long-term, institutionalized structures, such as research writing taskforces or academic communication centers to ensure continuous support. Overall, these expectations align with the ILS framework by emphasizing sustainable capacity-building and ongoing knowledge transfer instead of short-term interventions.

Table 1. Top five expectations reported by teachers.

Rank	Expected support type	Teachers mentioning (%)
1	Long-term mentorship program	76
2	Modular workshops on academic writing	73
3	Access to English-language databases and plagiarism check tools	68
4	Peer writing groups or journal clubs	61
5	Recognition and workload reduction for research engagement	57

4.5. Discussion

The findings indicate that L2 research-writing competence is shaped not only by individual ability but also by the institutional ecology in which teachers work. Ongoing linguistic and technical difficulties stem from systemic constraints such as limited mentorship, weak incentives, and inadequate access to academic resources. From an ILS perspective, research writing operates as a community-sustained linguistic resource through which teachers both articulate academic knowledge and transmit disciplinary expertise. Therefore, strengthening teachers’ L2 writing skills is vital to maintaining the broader ecosystem of English-mediated scholarship in vocational education. The study highlights three key shifts: L2 research writing should be treated as a sustainable skill requiring continuous institutional investment; responsibility for writing development must move from individuals to institutions through integrated professional support; and intergenerational collaboration, mentoring, and peer writing practices are essential for sustaining academic writing culture. These findings are consistent with prior research emphasizing the social and institutional nature of academic literacy (Hyland, 2016; Borg, 2013) and extend it by underscoring continuity, community, and sustainability in vocational higher education.

4.6. Summary

Overall, the study demonstrates that Vietnamese vocational-education teachers face multifaceted challenges in writing research papers in English. Their primary obstacles include limited academic vocabulary, restricted access to scholarly resources, lack of methodological confidence, and insufficient institutional mentoring. Although some support mechanisms exist, they are fragmented and short-lived.

Teachers' strong call for long-term, collaborative, and intergenerational support structures underscores the need for a sustainable capacity-building model, one that recognizes L2 research-writing ability as both a linguistic and institutional asset. Addressing these needs will not only empower teachers as individual writers but also strengthen Vietnam's vocational education system as a whole, enabling it to participate more fully in global academic discourse.

5. Conclusion and recommendations

This study examined Vietnamese vocational-education teachers' challenges, current support, and expectations regarding L2 English research writing. Despite acknowledging the importance of publishing in English for career development and institutional visibility, teachers face major linguistic, procedural, and affective barriers. They struggle with academic vocabulary, paraphrasing, and rhetorical structure, often drafting in Vietnamese first, which reduces coherence. Procedurally, limited training in research design, literature review, and data analysis hinders their writing, while anxiety, time pressure, and fear of rejection undermine confidence. Institutional and peer support exist but remain fragmented, with occasional workshops and library services offering limited long-term impact. Teachers emphasize the need for sustained mentorship, accessible resources, and continuous encouragement. Within the ILS framework, the findings show that L2 research-writing competence operates as collective linguistic capital maintained through collaboration, mentoring, and institutional continuity. Strengthening teachers' L2 writing capacity is thus vital for preserving the professional language ecosystem and preventing vocational institutions from becoming isolated from global academic discourse.

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Transforming Pre-Service Kindergarten Teachers through Vocational Training: An Evaluation of Assessment Tasks Using VACSR

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Abstract: This case study examines the transformation of assessment design in the vocational training of pre-service kindergarten teachers using the VACSR (Valuable, Authentic, Collaborative, Scalable, and Reflective) framework. It evaluates current assessment practices within the coursework at an vocational institution in Hong Kong, highlighting their effectiveness and limitations in preparing future kindergarten teachers. By integrating VACSR principles, the study proposes enhanced assessment strategies that foster meaningful learning experiences and promote reflective practice. The findings aim to improve the quality of assessment tasks in vocational teacher training, ensuring that pre-service teachers are well-equipped to meet the manpower demands of childcare and education.

Keywords: Assessment, Early Childhood Education, Evaluation, Pre-service Teacher, Vocational Education

1. Introduction

The pre-service kindergarten teacher programme has been a vital component of vocational education in Hong Kong for nearly four decades, playing a crucial role in supplying qualified personnel for childcare and education. Currently, 12 universities and higher education institutions offer various qualifications for pre-service kindergarten teachers, including up to nine higher diploma courseworks provided by vocational institutions and colleges (Cheng, 2024). Given this context, the importance of training pre-service kindergarten teachers through vocational education remains significant, emphasizing the need for its ongoing development. In this regards, this paper evaluates the assessment tasks related to the core coursework designed to cultivate the professional identity of pre-service kindergarten teachers within a vocational training programme in Hong Kong. Through this examination, the paper aims to serve as an exemplar for teacher educators, exploring how evaluation practices can enhance assessment methods in the context of vocational education.

2. Coursework brief and assessment plan

2.1. The two-year full-time higher diploma in childcare and education

Institution A offers a diverse range of higher diploma programmes across multiple disciplines, including business, childcare, elderly and community services, design, engineering, health and life sciences, hospitality, and information technology, all pitched at Level 4 of the Qualifications Framework. Among these, the higher diploma in childcare and education is a government-funded programme offered within the childcare and elderly and community services disciplines. This programme aims to prepare secondary school and diploma leavers for future careers in childcare and education. While primarily designed for students without prior experience working with children under five years old, its curriculum is vocationally oriented and tailored to a paraprofessional level, emphasizing the integration of theoretical knowledge and practical application. Comprising 348 credits, the curriculum encompasses both general education and vocational education components, as illustrated in Figure 1. Students engage in a spiral learning process that connects theory with practice, covering pedagogical studies, teaching experience (through work placements), and generic skills. Upon completing the programme, graduates are eligible to register as qualified kindergarten teachers under the Education Ordinance and as recognized childcare workers by the Social Welfare Department.

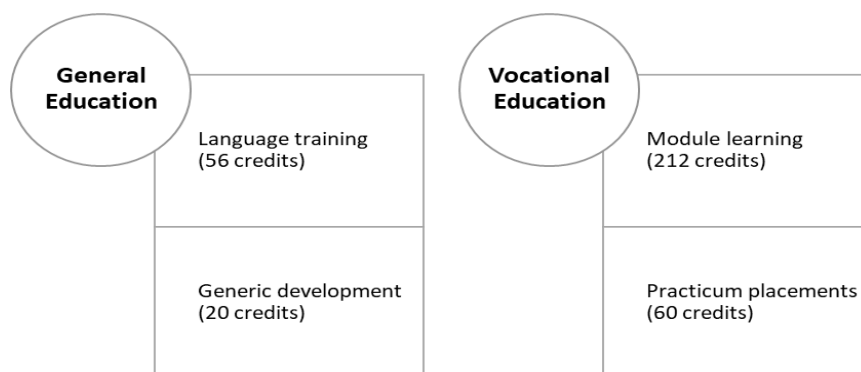


Figure 1. Curriculum design of the higher diploma in childcare and education

2.2. Assessment plan of the coursework ‘The Professional Growth of Early Childhood Educators’

"The Professional Growth of Early Childhood Educators" is a fifteen-credit learning coursework within the vocational education component that students must complete in their final semester. This coursework consists of 39 teaching hours over 13 weeks and covers topics such as teaching beliefs and philosophy, professional values, and career pathways in childcare and education. Upon completion, students are expected to achieve the following intended learning outcomes (ILOs):

1. Identify the professional role and qualities of early childhood educators for self-improvement
2. Build the students’ philosophy of education by harnessing what they believe in as educators
3. Design a professional development plan according to their developmental status in the field of early childhood education in Hong Kong

According to the syllabus, three assessment tasks–‘Class Participation’, ‘Reflective Practice’ and ‘Career Planning’–are set to assess the students’ learning outcomes and performance. Summary of the assessment plan is shown in Table 1.

Assessment	Strategy	Tasks	Targeted MILOs	Weighting (%)	Type of assessment (CA/EA)	Due Date
Class participation	Class Participation	Class participation in classroom discussions, including opportunities to develop and articulate thinking, deliver viewpoints, and receive feedback.	1	20	Continuous Assessment	Week 4
Reflective practices	Journal writing	Reflection on the topics discussed throughout the module to inform the development of the students’ beliefs or philosophy regarding education.	1, 2	30	Continuous Assessment	Week 9
Career plan	Poster presentation	A presentation by the students of their career plan that shows how they will develop their professional role and qualities, considering the formal and informal development opportunities.	1,2,3	50	End-of-Module Assessment	Week 13

Table 1. Summary of the assessment tasks

Each year, teaching team members are tasked with reviewing the its arrangements and student performance to identify potential enhancements for the following academic year. According to the coursework evaluation report for the academic year, over 400 students enrolled in this coursework past decade in average. The team members moderated the assessments and agreed that the assessment plan effectively represents the various areas of student learning throughout the coursework. However, they noted that student performance in reflective practices varied, with some students struggling to articulate their perspectives on education in the assessment tasks. Additionally, student feedback indicated that many found the reflective practice challenging and desired more guidance for completing the writing task. A summary of the comments from both team members and students regarding the assessment plan is presented in Table 2.

Assessment	Class participation	Reflective practices	Career plan
Team members’ feedback	<ul style="list-style-type: none"> • Appreciated the flexibility that encourages student participation in class activities and discussions. 	<ul style="list-style-type: none"> • Students’ performances are diverse. • Some students could not articulate their conceptual thinking about education in a written format. • Hard to assess students’ level of reflection. 	<ul style="list-style-type: none"> • Agreed that the poster presentation is an appropriate method for students to think about their career plans.
Students’ feedback	Not applicable	<ul style="list-style-type: none"> • Hard to grasp the expectation of the task. • Suggest team members share some samples of assessments that represent the different levels of student performance. • Expected a detailed rubric 	<ul style="list-style-type: none"> • Appreciated the assessment design and workload. • Suggested the presentation could be conducted via Zoom.
Further action	Remain as CA in the assessment plan for the next module run	Review its appropriateness as CA in the assessment plan for the next module run	Remain as EA in the assessment plan for the next module run

Table 2. Summary of team members’ and students’ comments on the assessment plan

3. Reconsidering ‘reflective practices’ as a continuous assessment

Based on the comments from team members and students regarding the assessment plan in the previous academic year, the appropriateness of the current assessment task—reflective practices—should be further reviewed. Journal writing, academically recognized as a form of reflective practice, can be described as “written material that is based on reflection and is relatively free writing, though it may be written within a given structure” (Moon, 2010, p. 187). In teacher education, it serves to assess how student-teachers integrate their acquired professional knowledge and values to form the foundation of

Guidelines/Requirements

- In this individual assignment, students are required to create a video log to talk about how the module learning has impacted their beliefs in education and promoted professional quality in respect of their careers.
- Students must complete the video log following the guiding steps:
 1. In the video log, every student should first describe one of their class discussions related to the topic of teacher quality that s/he found impressive.
 2. Second, students should illustrate how the discussion impacted their beliefs in education.
 3. Finally, the students should reflect on how their amended beliefs in education (illustrated in the second step) might promote quality in respect of their professional life.

their educational philosophies (Bolton and Delderfield, 2018; Boud et al., 1985; Rolfe et al., 2001). As a continuous assessment within the course, journal writing is expected to demonstrate students’ reflections and inform adaptations to the teaching content (Black, 2002; Black and William, 2010). Accordingly, the six key principles of assessment in vocational education and training, known as VACSR (Gravells, 2014; 2019), have been applied to frame the evaluation in reification, as shown in Table 3, and to revise the assessment plan, as outlined in Table 3.

Table 3. Evaluation of the reflective practices assessment task based on VACSR

3.1. Enhancement 1: Setting the guiding steps for the reflective practices

The context of vocational education and training is evident in the design of the reflective practices task. Studies (Cheng, 2019; 2022; Hodge and Smith, 2019; O’Shea et al., 2012; Smith and Blake, 2009) have shown that students in vocational institutions expect more assessment focused on the application of teachers’ guidance compared to university students, who prioritize deep conceptual thinking. This perspective on students’ learning expectations raises concerns about the relevance of the reflective practices task within the institutional context (Ashford-Rowe et al., 2014). Guided by Bloom’s taxonomy of educational objectives (Bloom et al., 1956), three new guiding steps (Figure 2) for the reflective practices task therefore were developed: (1) describing a class discussion concerning teacher quality, (2) illustrating how this discussion has influenced their beliefs about education, and (3) reflecting on how it can further enhance professional quality. These steps are organized by the complexity of the expected learning outcomes, enabling students to engage with lower levels of reflection before progressing to higher levels.

Items	Practical consideration	Problem highlighted	Enhancement
Valid	The assessment task covers the relevant subject content and is appropriate to the level of learning.	The assessment task is designed to cover the relevant subject content but the free writing of a reflective journal might not fit the students’ learning preferences and institutional contexts.	1. Set the guiding steps for the reflective practices
Authentic	The work can be verified as students’ work and be sufficient to check their performance.	The Turnitin programme can help to verify the authenticity of the students’ work.	2. Change the form of reflective practices to video log
Current	The work is relevant at the time of assessment, and the task and design are up-to-date.	The work is relevant at the time of assessment, but the means of reflective practices can be reconsidered as an e-assessment, which closely reflects current student learning practices.	
Sufficient	The work covers all the expected learning outcomes and assessment criteria.	The work covers all the required expected learning outcomes, but it is difficult for teachers to assess the students’ reflective abilities.	3. Reset the grading criteria of the assessment task.
Reliable	The work is consistent across all students at the same learning level over time.	Student performances regarding reflective journal writing are diverse, with some students unable to grasp the expectations of the task.	

Figure 2. Guiding steps for the reflective practices

3.2. Enhancement 2: Changing the means of presenting the reflective practices task as a video log

Journal writing is just one method of reflection and self-expression. For students who struggle with written self-expression, this can limit teachers’ ability to assess their reflective capabilities (Zulfikar and Mujiburrahman, 2018). Given that students

have become increasingly familiar with using technology for assessments in the post-pandemic period, video logs are proposed as a replacement for traditional reflective journal writing. In this approach, students will record their reflections using the camera on their laptop or smartphone and upload their videos to the Panopto Lecture Capture System (LCS) in Moodle. This technological shift accommodates a wide range of student learning styles. Students can upload video logs directly to the cloud, ensuring that files are securely accessible to both lecturers and students anytime and anywhere. This faster, simpler, and more secure method of recording may enhance students' engagement with the assessment task and motivate them to reflect on topics of interest. Additionally, teachers can provide time-coded feedback linked to specific moments in the video log, allowing students to view responses in context and facilitating continuous development (Cheng, 2020).

3.3. Enhancement 3: Rewriting the grading criteria of the assessment task.

Grading criteria are crucial at every stage of a reflective practices task, as they clarify teachers' expectations for students' writing (Moon, 2010; 2019). If both team members and students are unclear about the meaning of a given grade, it becomes challenging to ensure reliable judgments. This ambiguity can create tension between the assessment task and the quality of reflection, as indicated in the coursework evaluation report. To help students understand the established grading criteria for this new assessment task, a new rubric will be developed (Figure 3). To construct standards within the learning community, examples will be provided in class, facilitating discussions about the standards and what is required for the assessment. In addition to evaluating learners' performance through the grading criteria, the new rubric features a comment box, allowing team members to offer both positive and constructive feedback. This approach aims to help students identify their strengths and areas for improvement, fostering a personal and continuous dialogue between teachers and students (Abednia et al., 2013; Everett, 2013; Bolton and Delderfield, 2018).

RUBRIC – VIDEO LOG

Student Assessed	Assessor (s)				Date
Grade*	F (0-39)	D (40-49)	C (50-59)	B (60-69)	A (70+)
Criteria					
Description of the identified class discussion related to teacher quality (10%)	<ul style="list-style-type: none"> No description of identified class discussion is made 	<ul style="list-style-type: none"> The description is loosely presented and barely related to teacher quality 	<ul style="list-style-type: none"> The identified discussion is, in the main, described and is related to teacher quality 	<ul style="list-style-type: none"> The identified discussion is well described in how it is related to teacher quality 	<ul style="list-style-type: none"> The identified discussion is well described in how it is related to teacher quality
Illustration of how the discussion has impacted your beliefs in education (10%)	<ul style="list-style-type: none"> No impact is identified 	<ul style="list-style-type: none"> Identifies the impact at a minimal level without illustration of how the class discussion influenced the beliefs 	<ul style="list-style-type: none"> Identifies the impact with a limited illustration of how the class discussion influenced the beliefs 	<ul style="list-style-type: none"> Identifies the impact with some illustrations of how the class discussion influenced the beliefs 	<ul style="list-style-type: none"> Identifies the impact with a full illustration of how the class discussion influenced the beliefs
Reflection on how the identified beliefs in education might promote professional quality in respect of your career. (10%)	<ul style="list-style-type: none"> Show no evidence of critical reflection 	<ul style="list-style-type: none"> Shows very little evidence of critical reflection on how the identified beliefs might promote professional quality in respect of your career. 	<ul style="list-style-type: none"> Shows some traces of critical reflection on how the identified beliefs might promote professional quality in respect of your career. 	<ul style="list-style-type: none"> Shows a satisfactory level of critical reflection on how the identified beliefs might promote professional quality in respect of your career. 	<ul style="list-style-type: none"> Shows a good level of critical reflection on how the identified beliefs might promote professional quality in respect of your career.
<ul style="list-style-type: none"> Feedback 					<ul style="list-style-type: none"> Grade

Figure 3: New designed rubric for the reflective practices

4. Closing thoughts

This paper outlines the evaluation process for the assessment plan of the course "The Professional Growth of Early Childhood Educators" within a vocational education programme in Hong Kong. While proposing a redesign of the assessment tasks, we recommend maintaining the overall assessment framework while enhancing the reflective practices task and its rubric. To further develop the assessment, the teaching team can conduct individual learning reviews with students and analyze the statistics from the grading report. Additionally, feedback from both the examiner and students, obtained through the external examiner's report and student feedback surveys, can also serve as valuable tools for evaluating the effectiveness of the assessment plan. Beyond evaluation and enhancement, this paper emphasizes the critical need to refine teaching practices

in vocational education, tailoring approaches to meet the specific needs of both students and the industry. Moving forward, it is essential to prioritize ongoing evaluation and adaptation of our teaching practices, as a commitment to continuous improvement can significantly enhance the quality of education for future generations (Cheng, 2018; 2022; 2024).

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The Power of Friendship and Study Collaboration on the Development of Students'

Sense of Belonging: A Three-Year Longitudinal Study at Russian Universities

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ABSTRACT

Although the role of the university as a 'social capital constructor' has been validated by researchers across the world, the year 2022, when GenAI was brought into the public spotlight, has questioned this role through steady attempts to integrate AI advancements into different areas of academic life such as curriculum, delivery of learning materials, and even psychological support. Some researchers have already raised concerns around psychological effects, including a shift in the sense of belonging from human connections to GenAI that may result in social withdrawal. It has been shown that social integration serves as an essential condition for fostering students' sense of belonging. Although numerous factors constitute social integration, it remains unclear which of them and to what extent contribute to the development of students' sense of belonging in the Russian higher education context. The current study employs the conceptual model "Student Behaviour at University" developed by Maloshonok and Vilkova, which shares some ideas previously proposed in Tinto's student integration theory. Drawing on three waves of a longitudinal study of Russian undergraduate students (N = 455), the current research examines how students' involvement in extracurricular activities, friendships, and study collaborations are associated with their level of sense of belonging. The results of regression analysis indicate that the primary predictors of a higher sense of belonging are the quantity of students' friendships and their active participation in collaborative learning. In contrast, the quality of friendships and involvement in extracurricular activities do not significantly contribute to the development of students' feeling of attachment. These findings, situated within the Russian higher education context, offer broader implications for the literature on students' sense of belonging from a post-Soviet perspective.

KEYWORDS

sense of belonging, social integration, extracurricular activities, friendship, study collaboration

The Evolution of Digital Competency Framework for University Teachers: A Systematic Review

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ABSTRACT

With the rapid development of educational technologies, the digital competency of university teachers must evolve accordingly. This study conducted a systematic review of four databases—Web of Science, Scopus, EBSCOhost, and ProQuest—to answer two research questions: First, what are the components of existing empirically supported digital competency frameworks for university teachers in higher education? Second, what are the longitudinal changes among these frameworks? Following the PRISMA guidelines, 97 peer-reviewed journal articles in English from 2013 to 2025 were identified, from which seven empirically supported frameworks were extracted. The three most common components across these frameworks are (1) digital knowledge and application skills; (2) teacher professional development; and (3) technology-enhanced pedagogy. The evolution of three prominent frameworks—DigCompEdu, TPACK, and the UNESCO ICT framework—was also examined, revealing two key trends: (1) increased attention to ethical considerations when using digital technologies and (2) a greater emphasis on empowering students. This study suggests that teacher training programmes should incorporate digital knowledge and application skills, professional development, and technology-enhanced pedagogy as core components. Furthermore, ethical guidelines and strategies for empowering students should be integrated into these programmes. This research aims to inform the future development of a generative artificial intelligence competency framework for university teachers.

KEYWORDS

Digital competency, competency framework, university teacher, systematic review

Globalising Teacher Education through COIL: Towards English Teachers as Future-Ready, Multiculturally-Aware Team Players

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ABSTRACT

With recent technological advancements, COIL has become an increasingly popular approach for international exchange in higher education. This approach encourages virtual collaboration, supports learning foreign languages/content, and enhances intercultural awareness through shared learning outcomes and deep collaboration. This paper demonstrates how COIL can be utilised to internationalise teacher education through a postgraduate course jointly organised by a HK and a UK university. It documents the experiences of two cohorts (2023-24/2024-25) of MA(TESOL) students (n=155) in a core ELT methodology module. The COIL initiative aimed to align university teaching with future professional contexts, expand TESOL practices, enhance multicultural competence, and strengthen collaboration skills to nurture globally-ready graduates. With micro-teaching as the shared focus, the HK/UK student-teachers participated in collaborative lesson planning, material design, peer feedback, video annotation, and joint reflections on real classroom practices synchronously/asynchronously. Adopting an action research approach, the teacher-educators sought ways to leverage student-teachers' COIL experiences over 12 weeks through a collaborative online annotation platform and six webinars. Data included web-based written/spoken interactions, artefacts (co-created lesson plans/teaching materials), video-recorded teaching practices, questionnaires (n=152), semi-structured interviews (n=14) and reflective essays (n=22). The findings showed student-teachers' notable pedagogic/personal growth despite challenges. By comparing findings from the two student cohorts, the paper highlights strategies that promoted multicultural awareness, peer learning/professional exchange in the target language, teamwork, communication, problem-solving, and TESOL-related knowledge/skills (e.g., methodology, lesson planning/teaching). The paper concludes by discussing how COIL can be strategically integrated into cross-university curricula using synchronous/asynchronous activities to foster autonomy and cultivate more future-ready/globally-competent graduates.

KEYWORDS

English language teacher education, COIL, micro-teaching, collaborative online annotation, synchronous and asynchronous collaboration

Training “Safe” Teachers: A Genealogical Study of Teachers’ Professional Values, Conduct and Political Identity in Hong Kong Teacher Education under the National Security Framework

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ABSTRACT

Recent reforms in Hong Kong teacher education have intensified attention to teachers’ professional values, political responsibilities and conduct, especially in relation to the Basic Law and recent national security legislation. This paper presents a historical–genealogical study that uses a comparative-historical “context of contrast” as its research method, examining how official texts construct the figure of a “fit and proper” or politically “safe” teacher and embed these constructions in initial teacher education. The study is original in, first, reconstructing the policy trajectory through which teachers’ political identities and responsibilities have been redefined in teacher-education settings from late-colonial codes and circulars to recent guidelines on teachers’ professional conduct and national security education; and, second, foregrounding teacher-education spaces, rather than classroom practice, as key relays of national-security governance. Guided by an institutional layering and policy-imprinting framework, the study asks (1) how these texts define desirable and risky political attributes and behaviours for teachers, (2) how they draw boundaries between professional autonomy, personal expression and national security, and (3) how they position these expectations within teacher-education and professional-development policies. The analysis will be based on document study of ordinances, circulars, guidelines, teacher-education syllabuses and materials, attending to changing vocabularies, examples and role expectations. Initial reading suggests a move from relatively general professional ideals to increasingly explicit legal–political obligations, extending teachers’ responsibilities to off-campus speech and online behaviour. The paper will present an emerging map of this layered regime and discuss implications for the design of initial teacher education and the support of teacher professionalism in Hong Kong schools.

KEYWORDS

teachers’ professional values and conduct, political identity, national security education, teacher education, Hong Kong

A Case Study on the Identity of a Science Teacher in Primary School with a Liberal

Arts Background: "A Liberal Arts Graduate Teaching Science"

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ABSTRACT

The professional quality of science teachers in primary schools in China is insufficient, with teachers with a liberal arts background being the majority. The state has issued policies to promote the construction of the teaching team. Studying the identity recognition of science teachers in primary schools with a liberal arts background has strong practical significance. This study selected ten teachers, seven women and three men, all with a liberal arts background, who have been teaching science for 6 to 18 years and have outstanding teaching achievements as cases. Semi-structured interviews and observation methods were used to collect data, and the dynamic construction process of their identity recognition was analyzed through three-level coding with Nvivo20 software. The research found that the identity recognition of the ten teachers fluctuated in stages: in the initial stage, they felt pressure due to the lack of subject knowledge; in the middle stage, they gained a sense of achievement through student recognition and teaching awards; in the later stage, they faced new challenges due to changes in the curriculum standards. The male teachers had a more positive identity recognition because he was considered by colleagues and class representatives to have a physiological advantage in handling science knowledge. Eventually, all ten accepted the identity of "cross-disciplinary teachers" and found their own value. This finding is contrary to existing research and common sense, challenging the current situation of problems in the primary school science teacher team and questioning the implementation of school policies. Based on this, relevant suggestions for strengthening the construction of the primary school science teacher team are proposed.

KEYWORDS

Primary School Science Teacher, Teacher Identity, Background in Liberal Arts, Case Study

Implementing the 6P Pedagogical Mode with Generative Artificial Intelligence:

Focus Group Insights from Text-Based Courses

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ABSTRACT

In the AI-driven era of higher education, optimizing student learning efficiency while simultaneously fostering AI literacy and preserving critical thinking has become a critical priority. Unstructured AI use, however, frequently leads to over-reliance, dissemination of inaccurate information, and diminished student agency and ownership of learning. The 6P Pedagogical Model (Plan, Prompt, Preview, Produce, Peer Review, Portfolio-tracking), originally developed by EdUHK (Kong, Lee & Tsang, 2024), provides a structured framework to mitigate these risks. This study applied the 6P Model to text-based courses and solicited empirical evidence of its effectiveness through students' lived experiences. Thematic analysis of focus group interviews conducted in July 2025 reveals perspectives from undergraduate and postgraduate students enrolled in diverse subject studies, including English and Chinese Language Education, English for Academic Purposes, and Information and Communication Technology Education. This diversity reveals both common benefits and discipline-specific variations in the application of AI tools and the implementation of 6P Model. Overall, findings affirm the model's capacity to maintain academic rigour in text-based courses. The paper concludes by discussing practical implications and offering actionable recommendations for educators and institutions aspiring to integrate AI effectively and ethically. These include embedding systematic training on the 6P Model, establishing clear guidelines for AI citation and academic integrity, and developing novice-friendly workflows.

KEYWORDS

AI Literacy, 6P Pedagogical Model, Higher Education, Critical Thinking

Insight to Knowledge of Professional Development in English-Medium Instruction in Vietnamese Higher Education: A Lack of Disciplinary Specificity

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Abstract: *In order to improve its quality in teaching and learning, higher education, both in general and in English-medium instruction (EMI), necessitates various sources of support, among which lies professional development (PD). Nonetheless, the PD for EMI lecturers appears to over-focus on language use rather than teaching skills. Besides, several factors, especially disciplinary differences, have been reported to shape how EMI lecturers teach. Therefore, this paper, contextualised in Vietnamese higher education, attempted to investigate what lacks in the PD provided for EMI lecturers by analysing the official materials from a three-month PD course. It drew upon part of Sims et al.'s (2025) quadripartite theory about effective teacher PD, particularly its first dimension on (instilling) insight to knowledge, and Shulman's (1986) three categories of content knowledge, namely subject matter content knowledge, pedagogical content knowledge, and curricular knowledge. Data analysis revealed a lack of insight to knowledge, in which subject matter content knowledge, although mentioned, gravitated towards lecturers' responsibility and pedagogical content knowledge and curricular knowledge, although comprehensively described, lacked specificity in terms of disciplinary differences and their respective pedagogical practices and assessment methods. This failure calls for more consideration regarding disciplinary differences with relevant knowledge that will serve lecturers' EMI delivery.*

Keywords: professional development, insight to knowledge, pedagogical content knowledge, curricular knowledge, disciplinary differences

1. Introduction

It has been recognised that supporting lecturers is necessary for raising the quality of teaching and learning in higher education and that professional development (PD) constitutes one of the vital elements of that support. Not only is this true for higher education in general, but it is also particularly true for English-medium instruction (EMI). EMI can be referred to as “the use of the English language to teach academic subjects, other than English itself” (Dafouz & Gray, 2022, p. 163). Nonetheless, there is a relative lack of PD provided for EMI lecturers (e.g., Dang et al., 2023; Wang et al., 2025). Besides, when PD is provided, its focus has been skewed by the common misconceptions that EMI involves only a slight difference in the language of instruction (Richards & Pun, 2022) and that improving the English proficiency of EMI lecturers is crucially important (Dang & Vu, 2020; Helm & Guarda, 2015). Therefore, the primary focus of PD provided for EMI lecturers has been on language use rather than teaching skills.

Several different factors have been found to have a bearing on how lecturers in general and EMI lecturers in particular teach. These factors include but are not limited to lecturers' perceptions of their roles in class and disciplines. The first factor pertains to lecturers' perceptions of learning, teaching, and their roles in these processes (Prosser & Trigwell, 1999; Trigwell et al., 1999). The second factor is germane to disciplinary differences. That is, there exist certain differences between academic disciplines (Biglan, 1973), and these disciplinary differences have been found to influence lecturers' practices of teaching (e.g., Neumann, 2001; Pollio, 1996). For example, nearly three decades ago, Pollio (1996) pointed out that the lectures in natural or hard sciences had a tendency to be monologic while those in humanities tended to be dialogic. Disciplinary differences have also been found to influence a wide range of other factors such as expectations for students (e.g., Braxton, 1995). Braxton (1995) revealed that natural or hard sciences tended to have less communication of high expectations for students than social or soft sciences.

The foregoing factors, especially disciplinary differences, have also been found to shape how EMI lecturers teach. Specifically, a number of recent EMI studies (Lasagabaster & Doiz, 2023; Tang & Trent, forthcoming) have revealed the influence of disciplinary differences on EMI lecturers' practices of teaching. For instance, Tang and Trent's (forthcoming) study indicates that owing to the existence of paradigms in natural or hard sciences (Biglan, 1973), it is highly likely that EMI lecturers opt for teacher-centred pedagogy and employ monologues when teaching. Only too often, teacher-centred pedagogy and the “outcome-based view of learning” occur concurrently, and both direct attention to “short-term attainment of learning outcomes” (Stewart, 2021, p. 6). By contrast, as a consequence of a lack of paradigms in social or soft sciences (Biglan, 1973), EMI lecturers very often opt to adopt student-centred pedagogy and utilise dialogues when teaching (Tang & Trent, forthcoming). Indeed, EMI lecturers are claimed to adopt the practices of teaching that are typical of their disciplines (Schmidt-Unterberger, 2018).

In the context of Vietnamese higher education, although there has been a phenomenal growth in the implementation of EMI (Tang et al., 2024), scant attention has been paid to PD for EMI lecturers. At the outset of their EMI teaching journeys,

instead of being provided with PD specifically designed for them, EMI lecturers have been required to undergo Vietnamese-instruction medium PD (Tri, 2024). This means that EMI lecturers in Vietnamese higher education thus far have undergone PD that is carried out in Vietnamese and prepares them for teaching in Vietnamese rather than in English. Afterwards, PD has been reported to be provided, yet it has been found by EMI lecturers to be infrequent (Vo et al., 2022) and ineffective since it “did not focus on relevant knowledge to serve their EMI delivery” (Tri, 2024, p. 115). Considering the aforementioned factors that influence EMI lecturers’ teaching practices, the question as to what lacks in the PD provided for EMI lecturers is raised.

This paper is thus set out to answer the question by drawing upon part of Sims et al.’s (2025) quadripartite theory about effective teacher PD, especially its first dimension *insight to knowledge*, to analyse the data collected from the materials for PD published by the National Academy for Education Management, the Ministry of Education and Training, Vietnam in 2022.

2. Theoretical Framework

This paper draws upon Sims et al.’s (2025) quadripartite theory about effective teacher PD. According to Sims et al. (2025), so as to achieve continued improvement in teaching, PD should include four dimensions, namely (instilling) *insight to knowledge*, (building) *motivation*, (developing) *techniques* (to *skill*), and (embedding these changes in) *practice* (p. 219). Nonetheless, owing to the limited scope of this paper, only the first dimension is taken into consideration. It is necessary for PD to “provide *insight* ... about teaching and learning” (Sims et al., 2025, p. 217). Instructors’ knowledge forms the basis of their pedagogical practices (Sims et al., 2025). Shulman (1986) mentions content knowledge, and from his perspective, content knowledge falls into three main categories: subject matter content knowledge, pedagogical content knowledge, and curricular knowledge.

First, subject matter content knowledge refers to the understanding of the various ways in which the fundamental concepts and principles of a given academic discipline are organised to include its facts and “truth or falsehood, validity or invalidity, are established” (Shulman, 1986, p. 9). Second, pedagogical content knowledge is related to “the dimension of subject matter knowledge *for teaching*” (Shulman, 1986, p. 9). It involves first the methods for formulating and representing the content that renders it easy to understand to students (Shulman, 1986). Besides, it involves the knowledge about what helps students with or hinders the comprehension of the taught content (Shulman, 1986). That is, students tend to bring certain (pre)conceptions with them to the learning of the taught content, and in the event that students’ (pre)conceptions turn out to be misconceptions, lecturers should have a wide knowledge of the strategies that are “most likely to be fruitful in reorganising [students’] understanding” (Shulman, 1986, p. 10). Third, curricular knowledge is related to “the materia medica of pedagogy, the pharmacopeia” from which lecturers draw teaching tools that introduce or illustrate specific taught content and remedy or carry out an evaluation of the sufficiency of students’ achievements (Shulman, 1986, p. 10).

3. Data Collection and Analysis Methods

The authors collected the data from the official materials for PD designed and published by the National Academy of Education Management, the Ministry of Education and Training, Vietnam in 2022. The materials were written in Vietnamese and aimed at providing lecturers teaching at public universities in Vietnam with a comprehensive coverage of all the contents they are expected to master to prepare for an examination. On passing the examination, lecturers are awarded the certificate of Professional Standards for Lecturers, which proves their credentials for their teaching positions and helps secure them (Ministry of Education and Training, 2022). The materials have recently been used as the primary teaching materials for a three-month PD course run quarterly by the National Academy of Education Management. It was this course that the third author took and from which the materials were collected.

The materials were divided into 18 modules. Among these modules, modules 4 and 6 were found to be directly related to lecturers and teaching skills/ methodology. Specifically, module 4 concerns the development of the teaching workforce and certain basic skills in teaching activities of university lecturers, and module 6 concerns the organisational structure, teaching and assessing methods in higher education institutions. As a consequence of the direct relation of modules 4 and 6 to lecturers and teaching skills/ methodology, the contents of these two modules constituted the data. The processes of analysing and interpreting the data were guided by the theoretical framework. That is, the contents of modules 4 and 6 were analysed and interpreted with respect to *insight to knowledge* (Sims et al., 2025) and in light of the three categories of content knowledge: subject matter content knowledge, pedagogical content knowledge, and curricular knowledge (Shulman, 1986). The authors, separately, read the two modules, searched for potential themes based on the foregoing three categories of content knowledge, and selected the representative extracts. They then discussed until they arrived at a consensus about the themes and extracts. Subsequently, the extracts were translated into English by the first author, and the translations were checked by the other authors. Afterwards, the report, which is the Findings and Discussion section, was produced.

4. Findings and Discussion

Data analysis identified a lack of *insight to knowledge* (Sims et al., 2025). That is, regarding subject matter content knowledge (Shulman, 1986), although the modules mentioned this category of content knowledge, they were found to shift

the responsibility for it onto lecturers. With respect to pedagogical content knowledge (Shulman, 1986), the two modules appeared to comprehensively cover this category of content knowledge, yet a closer look at them revealed a lack of specificity in that disciplinary differences and the corresponding pedagogical practices were overlooked. Concerning curricular knowledge (Shulman, 1986), likewise, even though the two modules seemed to provide a comprehensive coverage of this category of content knowledge, they overlooked disciplinary differences and the corresponding assessment methods.

4.1. Subject Matter Content Knowledge: Responsibility on Lecturers' Part

Data analysis revealed that there was a mention of subject matter content knowledge in the two modules. Nevertheless, the modules did not seem to provide good coverage of this category of content knowledge in that the coverage appeared to lack depth. In addition, the responsibility for subject matter content knowledge – that is, for broadening and improving it – was found to be shifted onto lecturers. Specifically, it was stated in module 4 that:

Excerpt 1

Lecturers must have professional qualifications and extensive expertise; frequently develop their expertise by themselves; are able to use foreign language(s) and apply information technology in their professional activities.

In Excerpt 1 above, it was the use of the phrase *by themselves* that shifted the responsibility for subject matter content knowledge from the PD course onto lecturers. Such a shift in responsibility, however, seems fairly understandable, considering that the materials were designed to cater to lecturers across disciplines.

4.2. Pedagogical Content Knowledge: Comprehensiveness yet Lack of Disciplinary Specificity

It seemed that the two modules provided good coverage of pedagogical content knowledge. That is, they comprehensively covered it through a gamut of different teaching skills: presentation skill, skill of conducting seminars, skill of setting up group discussions, skill of developing teaching plans, skill of planning lectures, to mention but a few. Besides providing lecturers with the gamut of different teaching skills, the two modules were found to present each teaching skill in great depth. In the majority of cases, a step-by-step guide was provided. For example, the skill of setting up group discussions was presented with five steps that lecturers should follow (Excerpt 2 below).

Excerpt 2

Group discussions are a teaching method in which the lecturer divides the class into small groups (probably 2 or 4, or 6 – lecturer should not opt for an odd number of groups). All the members of a group have to discuss and agree on one opinion about the assigned topic.

Setting up a group discussion

- (1) Choose the topic for discussion
- (2) Define the discussion tasks
- (3) Form discussion groups: The number of students participating
- (4) Monitor the activities of each group
- (5) Present the outcomes of the discussions

Notwithstanding the aforementioned comprehensiveness, on covering pedagogical content knowledge, the two modules were found to lack specificity. That is, the seemingly comprehensive coverage of the gamut of different teaching skills did not take account of disciplinary differences. Since academic disciplines and their corresponding practices of teaching are different (e.g., Biglan, 1973; Pollio, 1996; Tang & Trent, forthcoming), the foregoing guide to setting up a group discussion could be held to be a one-size-fits-all one. For instance, it overlooked whether or not the application of group discussions in natural or hard sciences would be possible, given that the lectures have a tendency to be monologic (Pollio, 1996) and EMI lecturers usually opt for teacher-centred pedagogy and employ monologues when teaching (Tang & Trent, forthcoming). Furthermore, even within the bounds of possibility, the applications of group discussions in social and natural sciences are more than likely to play out differently, which was also overlooked in the guide.

4.3. Curricular Knowledge: Comprehensiveness yet Lack of Disciplinary Specificity

Similarly, the two modules were found to provide good coverage of curricular knowledge (Shulman, 1986). That is, they comprehensively covered it through a gamut of different assessment methods (Excerpt 3 below).

Excerpt 3

Design testing and assessment tools

Testing and assessment tools at tertiary level commonly take the form of writing. Lloyd Bostian identifies six types of common written assignments that can be used as effective tools for assessing students' reading and writing skills (Bostian & Lunde, 1995, p. 155).

- Pieces of writing 1–2 paragraphs long answering questions in class about a matter that has just been taught or a related topic. These pieces of writing are usually used for students explaining, commenting, introducing, or evaluating.
- Pieces of writing 1–3 pages long for students to analyse or synthesise reading materials, review book chapters, some learning materials.
- Pieces of writing 1–3 pages long to evaluate and discuss a topic of the course.

- Pieces of writing 2–5 pages long to research, describe experiments.
- Journals concerning students' thoughts and comments on the course, learning materials, etc.
- Essays 10–15 pages long about a certain topic.

Despite the comprehensiveness, when covering curricular knowledge, the two modules were found to be lacking in specificity. That is, the seemingly comprehensive coverage of the gamut of different assessment methods did not take disciplinary differences into consideration. As academic disciplines and their corresponding expectations for students and standards of achievement of learning outcomes are dissimilar (Biglan, 1973; Braxton, 1995; Stewart, 2021), the foregoing gamut of different assessment methods also appeared to be one-size-fits-all ones. First, they overlooked whether or not their applications in natural or hard sciences would be possible considering that natural or hard sciences tend to have less communication of high expectations for students than social or soft sciences (Braxton, 1995), teacher-centred pedagogy and the “outcome-based view of learning” occur concurrently, and both direct attention to “short-term attainment of learning outcomes” (Stewart, 2021, p. 6). Moreover, even within the bounds of possibility, the applications of different assessment methods in social and natural sciences are more than likely to play out differently, which was also overlooked in the coverage of the gamut of different assessment methods.

5. Conclusion

This paper is set out to answer the question as to what lacks in the PD provided for EMI lecturers. It arrived at the answer by analysing the data from the materials for PD published by the National Academy for Education Management, the Ministry of Education and Training, Vietnam in 2022 in light of the dimension of *insight to knowledge* (Sims et al., 2025), particularly the three categories of content knowledge identified by Shulman (1986): subject matter content knowledge, pedagogical content knowledge, and curricular knowledge. The findings revealed that the responsibility for subject matter content knowledge was shifted onto lecturers, and both pedagogical content knowledge and curricular knowledge were comprehensively covered yet overlooked disciplinary differences and the corresponding pedagogical practices and assessment methods respectively. By failing to provide discipline-specific pedagogical content and curricular knowledge, the current materials for PD and, in turn, PD appear to be most unlikely to enable EMI lecturers to navigate the distinct demands of their disciplines. In consequence, the development and implementation of PD materials and therefore PD should take account of disciplinary differences so that PD can become effective by focusing on and providing EMI lecturers with relevant knowledge that serves their EMI delivery.

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數字化領導力在提高小學教師幸福感中的作用

The Role of Digital Leadership in Enhancing Teacher Well-Being in Primary Education

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摘要

隨著數字化技術迅速整合進教育環境，小學教師面臨創新機遇與工作壓力的雙重挑戰。本研究以工作需求-資源（JD-R）模型為理論基礎，探討數字化領導力在提升初等教育教師幸福感中的作用。教師幸福感涵蓋正向情緒、滿意度、彈性、投入感及倦怠等多維結構，而數字化領導力則指領導者運用數字化思維、素養或技術推動組織變革的策略能力。本研究針對 830 位小學教師進行調查，測量數字化領導力、教師幸福感、工作需求與工作資源之間的關係。結果顯示，數字化領導力對教師幸福感具有顯著直接影響，並透過工作資源產生強烈的間接效應，顯示其能有效強化資源以提升幸福感。相對地，工作需求並未顯著中介數字化領導力與幸福感之間的關係。研究指出，數字化領導力在教育數字化轉型中扮演「資源架構師」角色，透過強化工作資源（如數字化工具與技術支援）以緩解壓力，而非僅減少需求。建議教育機構優先推動校長的數字化領導力培訓，並重新設計教師幸福感計畫以善用其雙重效益。此研究為數字化時代教育領導與教師幸福感提供實證基礎與策略參考，亦為未來跨情境與縱向研究奠定方向。

關鍵字

數字化；領導力；教師幸福感；工作需求；工作資源

Strand

AI, Metaverse and STEAM Education

人工智能、元宇宙及 STEAM 教育

Mecanum-Wheel Kinematics as a Pedagogical Medium for Vectors and Matrix Transformations

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ABSTRACT

Students often struggle to understand vectors and matrices, especially in interpreting vector decomposition and matrix transformations as meaningful operations. While robotics has shown positive impacts on learning, most studies focus on programming or problem-solving and largely target primary or lower-secondary students. Research that uses robotic kinematics as a representational system for upper-secondary mathematics remains limited. This proposal introduces a novel approach that employs the kinematic model of a Mecanum-wheel platform to teach vectors and matrix transformations in Secondary Five mathematics. Because the platform's omnidirectional motion is governed by a linear mapping from robot velocities to wheel speeds, it provides a tangible demonstration of vector addition and matrix-vector multiplication. Guided by the Concrete-Representational-Abstract (CRA) framework and embodied cognition, the approach aims to connect physical interaction, visual representations, and formal algebraic reasoning. A small pilot will explore the feasibility and learning affordances of this design, but the central contribution is the introduction of a robotics-enabled pedagogical method for teaching abstract mathematical ideas. This work positions robotics not merely as programming tools, but as mathematical representational media for secondary learners.

KEYWORDS

Robotics in Education, Kinematics, Secondary Mathematics Education, Constructionism, Embodied Cognition

Physical Robot Companionship for Language Learning: Using the Unitree Go2 with University Students

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ABSTRACT

Though Artificial Intelligence (AI) chatbots have become an alternative tool for language practice, they, however, lack physical presence and multimodal interaction that people cannot feel and touch, where the embodied cognitive theory claims these characteristics may enhance learning, particularly for speaking skills, where anxiety often inhibits practice. Additionally, university students now face increasingly high pressure from academic work, which they require emotional support with more educational resources, and screen-based tools cannot satisfy this companionship role if they are introverted. This proposal, with the deployment of the Unitree Go2 robot dog, provides a framework for utilizing this as both a language learning partner and an emotional companion for university-level students. This robot has functions of gesture demonstration, spatial proximity with scan, sound recognition and output, and tactile engagement, in which interactions cannot be made with virtual AI chatbots. Go2's dog-shaped form provides distinct advantages for this dual purpose. By integrating language models with robot dog's expressive movement, it enables natural peer-like interaction for speaking practice. We consider the Go2 as a peer facilitator but not a formal tutor for conversational practice, emphasizing implicit learning through dialogue and simultaneously providing companionship to support students who are under pressure. This objective of this framework is to integrate robot-assisted language learning and address the social and emotional needs of contemporary college students.

KEYWORDS

Robotics in Education, Embodied Cognition, Language Learning, Multimodal Interaction, Social Companion

Twenty Years of Research on Artificial Intelligence in Academic Writing: A Systematic Review

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Abstract: *The application of artificial intelligence (AI) in academic writing has received much attention in recent decades. To identify and evaluate the current state of empirical evidence, we conducted a systematic review of the published research that has investigated academic writing and the use of AI. Findings show that four general claims emerged across our analyses of 58 empirical studies published in peer-reviewed journals from 2004 to 2024. Each claim has empirical support but each also justifies future research and refinement: (1) Different users have different understandings of the definition of AI; (2) Mixed methods that involve questionnaire and analysis of writing between human and Chat GPT generated essays are common in conducting AI research; (3) Student perceptions of GenAI influence their frequency of utilization of AI tools; and (4) Instruction can help students improve the use of AI tools more effectively. The findings suggest that it is crucial to educate students on the ethical use of AI tools in improving their writing. These synthesized studies show that AI tools are indeed widely applicable in academic work to refine writing, organize content, check writing for errors, and get feedback. Pedagogical implications and future research directions will be discussed in the paper presentation.*

Keywords: Artificial Intelligence, Academic Writing, Student Perceptions, Instruction

1. Introduction

The application of artificial intelligence (AI) in academic writing has received much attention in recent decades. To identify and evaluate the current state of empirical evidence, we conducted a systematic review of the published research that has investigated academic writing and the use of AI. This paper aims to examine artificial intelligence (AI) in academic writing in terms of the users' perception, applicability and effectiveness of AI. The review is guided by the following research question: How useful is AI in academic writing?

2. Methodology

To analyse the aspects of AI in academic writing, 58 articles were examined in this systematic review. With reference to Cumming et al. (2016), Benson et al. (2009), Gao et al. (2014), and Wang and Gao (2008), this paper aims to emulate the structure for compilation. In the preliminary search, both ProQuest and EBSCOhost ERIC database was used to identify relevant articles using the following keywords: "artificial intelligence", "AI", "academic writing", "second language", "third language", "foreign language", "writing", "essay", "co-construct", "computer", "technology", and "online". The search was also limited to published peer-reviewed scholarly articles, literature reviews, and academic journals that were published between 2004 and 2024. Only articles published during this period were considered because it would focus on the recent developments of AI, as well as include articles that examined the use of AI in education. Only the first sixty articles were considered for analysis from ProQuest database, while EBSCOhost ERIC only yielded four articles, of which all four were analysed. To further supplement the findings outside of the databases, two most relevant and recent articles were screened for the reference list: AbdAlgane and Othman (2023), and Chan and Hu (2023). The total number of relevant articles to be included in this paper was fifty-eight. Based on the above research question as the inclusion criterion, this paper focuses on examining articles that analyses AI in education, specifically, AI in academic writing. Articles that examined writing proficiency and classroom instruction without the inclusion of AI technology, analysis of writing via syntactic complexity, analysis of AI in education but not in writing, use of technology that is not AI, analysis of AI video materials, AI tools that examined speech, and analysis of plagiarism issues were excluded. Only published peer-reviewed articles that were written in English were considered, and any preprint articles were excluded. The collection of articles was further supplemented by repeating the same process used to search ProQuest and EBSCOhost ERIC database in the Academic Search Complete (EBSCOhost) database. However, only the first ten articles were considered for analysis to make up for the shortfall of articles to be analysed in this paper. Any duplicates were removed before the analysis of articles. Both authors of this article have met every week to discuss, compile and refine the findings reported below.

3. Findings and Discussion

In analysing several relevant studies relating to the application of AI and its incorporation in academic writing, several claims have been identified, starting with the varying definitions of AI that have been examined.

3.1. Claim 1: Different Users Have Different Understandings of the Definition of AI

The definition of AI has changed over the years and can be defined in various ways due to its evolutionary nature and usage in multitude. Of which, Popenici et al. (2017) defined AI as “computing systems that are able to engage in human-like processes such as learning, adapting, synthesizing, self-correction and the use of data for complex processing tasks” (p. 2, as cited in Crompton & Burke, 2023). Several authors (Adiguzel et al., 2023; Al Mahmud, 2023; Crompton & Burke, 2023; Gherhes & Obrad, 2018; Zitouni, 2022) were found to attribute the term “artificial intelligence” to John McCarthy, who first coined the term in 1956, to designate basic types of thinking machines, in which has been used to achieve goals in various fields, including education. AI was also defined as “a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations or decisions influencing real or virtual environments” (Organisation for Economic Co-operation and Development, 2019, p. 7, as cited in Huang et al., 2023). AI then pertains to the ability of digital computers or robots with the ability to carry out tasks commonly associated with intelligent human beings, including “the study of agents that receive precepts from the environment and perform actions” (Russel & Norving, 2009, p. viii, as cited in Zitouni, 2022), indicating that these machines possess human intelligence and can act humanely and rationally (Sumakul et al., 2021). Gardner et al. (2020) have summed up the definition of AI to be the culmination of machine ‘learning’, where a computer is ‘taught’ how to interpret patterns in data and ‘trained’ to undertake predetermined actions according to those interpretations.

Generative AI (GenAI) is a subset of AI that focuses on new content generation (Chan & Zhou, 2023; Chan, 2023b), which can be defined as an unsupervised or partially supervised machine learning framework, utilising deep learning to generate manmade relics via the use of statistics and probabilities (Baidoo-Anu & Ansah, 2023), and ChatGPT can be subsumed under a type of GenAI that encompasses a group of machine learning algorithms designed to generate new data samples capable of mimicking existing datasets, possessing the ability to tackle given prompts and produce human-like output (Berg, 2023; Chan & Hu, 2023; Chan, 2023). Generative Pre-trained Transformer (GPT) are models that use large amounts of publicly available digital data to read and produce human-like text in several languages and can creatively write either a paragraph or a full research article convincingly, or near convincing on almost any topic (Aydin & Karaarslan, 2023 as cited in Baidoo-Anu & Ansah, 2023). ChatGPT is a public facing chatbot that generates texts based on human-provided prompts, learning autonomously from large corpora of language, or large language models (LLMs), and the internet to statistically predict the next most probable response (Escalante et al., 2023; Parker et al., 2023; Peres et al., 2023).

Based on the collated definitions, this paper then therefore defines AI as intelligent thinking machines that can engage in human-like processes to carry out tasks (Crompton & Burke, 2023; Huang et al., 2023; Zitouni, 2022), and act humanely and rationally by learning from patterns in data (Gardner et al., 2020; Sumakul et al., 2021).

3.2. Claim 2: Mixed Methods that Involve Questionnaire and Analysis of Writing between Human and Chat GPT

Generated Essays are Common in Conducting AI Research

With the focus on AI in academic writing, methods researchers used to conduct AI research should be analysed as well, and it was found that the most common method was to understand the attitudes and perception of students and teachers regarding the integration of AI in education and writing, where 12 studies (AbdAlgane & Othman, 2023; Barrett & Pack, 2023; Chan & Hu, 2023; Chan & Tsi, 2023; Chan & Zhou, 2023; Chan, 2023a, 2023b; Gherhes & Obrad, 2018; Jeffrey, 2020; Marzuki et al., 2023; Sumakul et al., 2021; Yousofi, 2022; Zitouni, 2022) were found to examine the use or misuse of the technology. In Escalante et al. (2023), a mixed method study was carried out to test students’ performance after receiving either human or AI-generated feedback, and a questionnaire was used to understand the type of preferred feedback. Another similar study was conducted by Hamamah et al. (2023) where the Nominal Group Technique (NGT) was used in place of surveys to understand the challenges Indonesian researchers face and use of AI tools in writing their papers. Additionally, one study (Du & Gao, 2022) analysed factors that would influence teachers’ use of AI tools in EFL teaching via a constructed questionnaire that was based on a multi-criteria decision-making framework, and four studies (Baidoo-Anu & Ansah, 2023; Fyfe, 2022; Liu et al., 2024; Zhai, 2022) used ChatGPT to generate a paper or assignment via means of prompts and queries provided by the users for further refinement or expansion on the topic. Studies that examined the ability of AI either in terms of content generation or in grading was Zindela (2023), that compared the writings between students and ChatGPT-generated essays on three different topics to examine the lexical and syntactic complexity, Alberth (2023), that analysed the functions and accuracy of ChatGPT to provide arguments, citations, and statistical analysis, Kloppers (2023), that had human raters examine the texts graded by Grammarly to annotate their level of agreement to the correction, and seven other studies (Almusharraf & Alotaibi, 2022; Coniam, 2009; Geckin et al., 2023; Ivanovic, 2023; Liu & Kunnan, 2016; Parker et al., 2023; Wang, 2022) made a comparison between human raters and AI to understand how AI performs against humans. Building on this, Mizumoto and Eguchi (2023) carried out a study that tested the AES ability of ChatGPT with and without linguistic features, while Lee and Briggs (2021) studied how the use of machine translation could aid ESL students’ writing, and Li et al. (2023) examined the enduring effects of ChatGPT in EFL students.

In order to test the effects or influence of AI, eight studies (Abbas et al., 2023; Ajabshir & Ebadi, 2023; Al Mahmud, 2023; Al Sharoufi, 2022; Gayed et al., 2022; Mohammad et al., 2023; Reynolds et al., 2021; Saricaoglu, 2019) examined texts or essays for the change in performance before and after using an AI tool to facilitate the learning or writing process, where Bai and Hu (2017) and Gao (2021) specifically analysed the accuracy of feedback provided by Pigai, an online assessment

platform meant for Chinese EFL learners that can provide specific feedback and suggestions either at the sentence or collocation level, and Liu et al. (2023) combined peer evaluation and automated feedback to examine the change in ESL students' writing performance. Abdelghafar et al. (2022) on the other hand, examined how WebQuest, a learning structure that provides learning resources and evaluation rubrics, can improve ESL students' writing skills and decrease learning anxiety. Helping understand the commonly used tools by students, Moore et al. (2016) and Tight (2017) identified tools with either grammar, spell check, word prediction or text-to-speech functions were used in high frequency to be useful in improving or assisting their writing. The latter found that Google Translate, WordReference.com and SpanishDict were the most common internet resources that provided grammar and spell checking for Spanish students.

3.3. Claim 3: Student Perceptions of GenAI Influence their Frequency of Utilization of AI tools

With most researchers looking into understanding AI usage and its application in academic writing, the perceptions of the users were examined since they would have had first-hand experience interacting and integrating the technology. Depending on their area of study, students get different information about AI, causing discord about how informed they were about AI (Gherhes & Obrad, 2018), and feeling a lack of sufficient information about the current developments of AI (Jeffrey, 2020). Researchers also found that students did not feel too strongly about AI's rapid development, where students either believed that it will positively influence society (Gherhes & Obrad, 2018), or they have mixed feelings towards it, showing indication that this development was not a cause for concern, and should be embraced instead (Jeffrey, 2020). However, in the same paper, Jeffrey (2020) noted that the more informed and updated participants are about AI are worried about the constant development of it, the possibility of replacing human jobs, and the concerns about AI intelligence developing beyond human intelligence, all while stating the belief that AI will provide benefits and positively impact society. In terms of academic writing, a study examining the role of teachers in education found that human qualities like creativity, emotions, and critical thinking could not be replicated by AI, even as AI advances and supplements the learning process (Chan & Tsi, 2023). This study also found that an overreliance on AI technologies could potentially allow students to develop their knowledge, while sacrificing the development of essential life skills because AI lacks emotional intelligence, cultural sensitivity and capability to lead the personal growth and development of students' – a vital role teachers play. Emphasis on the value of teachers was placed by students for the qualities and competencies teachers possessed, and AI tools should be used to support teaching strategies where both teachers and students can learn in the classroom (Chan and Tsi, 2023). Additionally, the integration of AI allows teachers to allow for the provision of comprehensive training and professional development programs that enhance the teaching practices of teachers', support student learning, and saves time from administrative tasks (Ivanovic, 2023). Students and teachers were also found to hold favourable opinions when incorporating AI technology in learning and teaching practices, but they also recognize the benefits and concerns such as providing personalized feedback, improving academic performance, and the difficulty in identifying AI technology usage (Chan, 2023b). Researchers in one study found improvement in participant writing, better performance in structure, formulaic expression usage, and clarity of argument when an assistive rhetoric phrase (ARP) writing system was used (Abbas et al., 2023). Apart from students, researchers whose first language is not English also face difficulty in producing a paper in English, which led to the usage of tools such as Google Translate and WordHippo to look up words, synonyms and definitions, as well as Grammarly to check their work for grammatical errors to guide their writing process. However, this study also indicated that participants all valued consulting with other experts in the same field, despite having these tools at their disposal (Hamamah et al., 2023), indicating that human interaction would be able to better provide the researchers with more nuanced information and guidance, as compared to AI.

The intention of use or mistrust in these tools should be studied, where a student's perceived value of GenAI can affect the intentions of utilization in an educational context as its value increases in terms of efficiency, idea generation, and immediate personalized feedback (Chan & Zhou, 2023). Both students and teachers found it acceptable to use AI during the early stages of the writing process and generating a model essay for reference, rather than its usage during the later stages of writing (Barrett & Pack, 2023). Students were also found to disagree less than teachers regarding appropriate GenAI usage without disclosure, while teachers tend to disagree less about using GenAI to provide feedback or evaluate student writing. Teachers were also found to have a more positive outlook on teacher use of AI, but both groups reported concern about how AI might be used, despite agreeing on its usefulness (Barrett & Pack, 2023). AI tools were generally beneficial for nurturing idea generation, providing instantaneous feedback and suggestions for content reorganization, helping students improve writing clarity and establish a logical, however, there is a risk of over-reliance on these tools that could potentially limit critical thinking and personal creativity in students' writing (Marzuki et al., 2023).

3.4. Claim 4: Instruction can Help Students Improve the Use of AI tools More Effectively

The effective use of AI tools can only be achieved with sufficient knowledge on their use, thereby making training and familiarization pertinent (Alharbi, 2023; Chan, 2023b; Moore et al., 2016; Zhai, 2022). There is an emphasis on training learners to understand Grammarly feedback as there are identifications not connected to a correction, making it crucial for users to know how to identify and possess the ability to differentiate effective feedback (Kloppers, 2023; Warschauer et al., 2023). However, AI is extremely reliable in conducting work and presenting knowledge, but little has been done to incorporate AI in learning tasks, which is not efficient use of available AI tools (Zhai, 2022), because technology should complement educational and learning theories, allowing for optimized learning efficiency and effectiveness (Adiguzel et al., 2023). ChatGPT usage can also help teachers and researchers cut down on the amount of time spent curating teaching schedules and

examination questions that can be primed according to requirements and rubrics, allowing them to use the additional time with other work instead (Adiguzel et al., 2023; Ivanovic, 2023; Peres et al., 2023). One useful feature of ChatGPT is its ability to detect plagiarism, where the AI tool can make comparisons against other sources or specific passages thereby providing any identified similarities or differences between texts. This detection ability can also be integrated into existing plagiarism checkers by automating the process via specific phrases from suspicious texts, providing contextual understanding and analysis when comparing discrepancies (Ivanovic, 2023).

However, there are also issues to consider when using AI tools, some of which were mentioned in several papers (Adiguzel et al., 2023; Baidoo-Anu & Ansah, 2023; Chan, 2023b; Peres et al., 2023), such as information unreliability and inaccuracy, potential biases in data, ethical and integrity concerns, and lack of human interaction. AI usage also results in a reduction in quality of educational experience, an over-reliance on smart technology, and the lack of separation or indication of AI usage. All of which has been brought up in the previous sections, showing a convergence on the collected data and consensus. Users should also be wary of the generated information as ChatGPT has the tendency to cite made up articles and provide inaccurate information (Baidoo-Anu & Ansah, 2023; Fyfe, 2022; Liu et al., 2024). Since LLMs are trained using existing data, unintended biases might be hard coded into the models, influencing its generated outputs (Liu et al., 2024; Peres et al., 2023). In its application of AI, especially in academic writing, issues such as plagiarism and authorship surface. Ethical concerns range from students using technology to cheat on examinations, to plagiarized content in journals (Parker et al., 2023). Students and teachers were found to share the sentiment about the potential misuse of AI, and the subsequent need for higher education institutions to implement risk mitigation plans (Chan, 2023b). There was also an emphasis on the importance of AI literacy to increase the likelihood of AI technology in learning, so that users can know how to effectively utilize and take advantage of AI (Chan & Zhou, 2023; Chan, 2023b). The ability to distinguish between AI and human generated work could allow for the incorporation of AI for unique insights and perspectives, and personalized feedback. Using ChatGPT for paraphrasing and translation work is still ethical as long as majority of the paper was completed by the author, and the extent of utilization of AI technology was clearly indicated in the paper, adhering to academic integrity and transparency guidelines (Alberth, 2023; van Dis et al., 2023). Plagiarism is defined as the act of not crediting, knowing and wholesale adaptation of someone else's work without proper acknowledgement or permission and passing it off as one's own original work (Chan, 2023a; Fyfe, 2022). Examining AI plagiarism showed that students recognized using AI tools to generate and copy content to be plagiarism, however they faced difficulties in separating using AI as a tool to supplement their writing, or as an enabler to academic misconduct (Chan, 2023a). To avoid such misconduct, guidelines and policies should be improved to account for AI plagiarism, to ensure academic integrity. An author is defined by Berg (2023) as the person that stands behind the written work, who speaks on its behalf, and allows authors to take credit to prevent those without attributing to claim credit, but not intended as a reflection of those that did not. Berg also added that AI generates an idea as a response to user input, not initiating any queries, and the value of the generated text is subjected to the user's choice of application.

4. Conclusion

In conclusion, LLMs might be built into word processing software, making it even harder to differentiate between human and AI drafted work (Berg, 2023; van Dis et al., 2023). With the increasing functions and accessibility of AI tools, English learners might turn to using AI for better articulation and integration of first language learners writing samples into their own work, which might be seen as plagiarism or patchwriting since AI would enable ESL students to generate work of a higher standard without requiring much expertise (Warschauer et al., 2023). However, despite its effectiveness in providing corrective feedback, no long-term improvement was found (Alharbi, 2023). Therefore, there is a need to educate students on the ethical use of AI tools used in improving their writing (van Dis et al., 2023). These synthesized studies show that AI tools are widely applicable in academic writing to refine writing, to organize content, check writing for errors and grading, and provide feedback, replacing labour intensive work normally completed by humans.

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Exploring Automated Feedback and Goal-Setting to Improve Speaking Skills at the Graduate Level

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ABSTRACT

Individual class oral presentation is an important assessment component in many graduate-level courses. Many students whose first language is not English face challenges in oral presentations. Instructors focus on teaching the subject matter. They often lack time or expertise to teach speaking as a skill. A technology-enabled application, such as Speeko, can address key aspects such as pronunciation, intonation, and pacing towards effective oral communication. This study aims to answer a research question: How do graduate students make use of the AI-based Speeko application to improve their speaking skills, and to what extent do they benefit from it? Participants were students in an elective course offered by the Master of Arts (Applied Linguistics) Programme at a university in Singapore in the January 2025 semester. Data were collected through a semi-structured interview, a goal-setting survey, and student oral presentation. The research team provided a scaffolding session to introduce the Speeko application and its affordances to students. Findings show that Speeko's assessment and feedback are accurate in terms of pace, fillers, pausing, intonation, and articulation. There is limitation in its assessment of word choice and content of oral presentations. This study contributes to an improvement in student learning outcomes. Specifically, the AI-based application can provide students with personalized feedback which helps them improve their performance as they know the specific areas that need more work. This helps them achieve their goal of giving a clear oral presentation and convincing the audience of their ideas and propositions.

KEYWORDS

Automated Feedback, Goal Setting, Speaking Skills, Graduate Study, Artificial Intelligence

Assessing Problem-Solving Competence Among Pre-University Students in the Era of Innovation and STEAM

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ABSTRACT

In an age marked by rapid development and widespread adoption of artificial intelligence, cultivating problem-solving competence within formal education is essential to prepare the students for the complex and dynamic challenges of the swiftly changing world. To better understand the development of problem-solving competence in higher education, this study investigates the problem-solving capability of incoming first-year students with diverse backgrounds in a new innovation and technology programme at a university in Hong Kong. Using a mixed-methods approach, we analysed students' problem-solving competence through quantitative self-profiling of skills as well as qualitative assessment of their ability to tackle ill-defined problems and their perception of problem-solving. Our findings highlight variations in students' abilities across key dimensions of problem-solving, including problem identification, creativity, stakeholder analysis, logical reasoning, and decision-making. While the self-profiling data provided insights into students' perceived strengths and weaknesses, the exercises in which the participating students attempted ill-defined problems revealed disparities between their self-perceived and actual abilities. Students' reflection of what constitutes and nurtures problem-solving competence were also analysed. This baseline assessment provides critical insights into the problem-solving capabilities of first-year students and establishes a foundation for longitudinal tracking of competency development throughout the four-year programme. By identifying the specific gaps between perceived and actual competencies, this study underscores the need for educational interventions to bridge these gaps and ensure students are better prepared to address complex, real-world challenges. The assessment framework, after validation via future phases of this study, can also be applied to other pedagogical investigations under similar contexts.

KEYWORDS

problem-solving, assessment, pre-university students, mixed-methods approach, innovation and technology

Exploring the Use of AI Chatbot for University Student Well-Being: A Systematic Review of Social Implications and Emotional Conversational Skills

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ABSTRACT

Recently, university students faced significant pressing psychological challenges, including anxiety, distress, disorders, and frustration. These issues often stem from social isolation, academic pressures, environmental concerns, stigma, and limited access to support services. Digital well-being frameworks can promote students' emotional, mental, and psychological health. AI chatbots provide alternatives and innovative solutions for reinforcing emotional conversational skills and personalized counseling. Digital tools facilitate communication by providing useful conversations with noun phrases, empathetic responses, and practical advice, effectively reducing distress and peer stress. One notable example is Woebot, which employs cognitive behavioral therapy (CBT) to provide emotional support, helping users manage stress and anxiety through personalized interactions. This research also provides a comprehensive literature review by selecting and summarizing 30 academic publications and literature and empirical methods, analyzing surveys and random sampling, to conduct a comparative analysis of various AI chatbots (e.g., ChatGPT, DeepSeek, Doubao, and POE). Pre-test and post-test evaluations will measure improvements in calmness, confidence, happiness, and mood among university students from diverse academic backgrounds and disciplines. Research explores the application of cognitive behavioral therapy (CBT), which helps people manage problems by changing the way they think and behave and facilitates understanding of user behaviors and emotional support mechanisms. However, this paper acknowledges the constraints of considering how to use the AI chatbot and counselling outside research in the university, which need more social consensus. Overall, this research aims to summarize the emotional support needs of university students and the impact of effective emotional conversational skills on their well-being.

KEYWORDS

AI Chatbot, Well-being, Emotional Conversational Skills, Counselling, Cognitive Behavioral Therapy (CBT)

The Impact of AI Agents with Self-Regulated Learning Processes and Retrieval-Augmented Generation on High School Students' Learning Performance and Attitudes in Hand-on Activity

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ABSTRACT

In the context of 21st-century educational reform, fostering students' interdisciplinary integration and self-regulated learning (SRL) abilities has become a central focus. Taiwan's 108 Curriculum Guidelines emphasize competency-based instruction, placing particular importance on STEM education and programming, with the goal of cultivating students' systems thinking and problem-solving abilities through inquiry and hands-on activities. However, high school students often encounter difficulties in debugging and understanding abstract programming concepts. Recently, Generative Artificial Intelligence (GAI), such as ChatGPT, have been introduced into classrooms, yet challenges remain regarding the reliability and factual accuracy of AI-generated content. To address these limitations, this study integrates Retrieval-Augmented Generation (RAG) technology with SRL theory and introduces an AI agent as an intelligent teaching assistant. RAG enhances the accuracy and traceability of generated responses, while SRL scaffolding supports students in planning, monitoring, and reflecting on their learning processes. The AI agent provides adaptive feedback and tiered prompts to help students overcome learning barriers and engage in continuous self-regulation. This study will adopt a quasi-experimental design with 80 first-year high school students, divided by class into experimental and control groups. The experimental group uses an SRL-scaffolded AI agent integrated with RAG, whereas the control group employs an SRL-scaffolded generative AI with RAG during a ten-week hands-on activity. It is expected that this integrated instructional model combining AI agents, RAG, and SRL will effectively improve students' fundamental programming skills, project performance, and metacognitive regulation.

KEYWORDS

SRL, Generative AI, RAG, AI agent, Metacognitive

The Impact of a Generative AI Teaching Assistant Integrated into a Bilingual STEAM Hand-on Activity on Students' Learning Achievement, Curiosity, English Vocabulary, and Creative Performance

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ABSTRACT

In 21st-century education, STEAM learning has become essential for developing interdisciplinary competence and creative problem-solving. In Taiwan, the 108 Curriculum emphasizes inquiry-based, competency-oriented instruction that integrates language learning, technological literacy, and hands-on creation. The 6E instructional model offers a systematic framework that supports conceptual development, iterative exploration, and experiential learning within bilingual STEAM environments. Concurrently, advances in Generative AI have enabled educational robots to provide real-time dialogue, multimodal interaction, and adaptive feedback, offering new instructional possibilities for young learners who often face dual challenges in language comprehension and STEAM concept acquisition. This study employs a quasi-experimental design involving 80 lower-elementary students who will participate in a five-week bilingual STEAM curriculum centered on constructing a functional vacuum cleaner. The experimental group will learn with an AI-enhanced robot powered by generative language models, capable of delivering personalized prompts, interactive questioning, visual interpretation, and immediate feedback. In contrast, the control group will interact with a robot that delivers comparable but pre-programmed instructional content. Learning outcomes will be examined through a STEAM knowledge test, English vocabulary assessment, curiosity scale, and product-based performance evaluation. Data will be analyzed using ANCOVA and independent samples t-tests to determine group differences. The study aims to investigate the extent to which generative-AI-integrated robots can enhance students' language comprehension, motivational engagement, and creative STEAM learning processes. The findings are expected to contribute empirical evidence and practical implications for the design of AI-supported instructional systems in early elementary education.

KEYWORDS

Generative Artificial Intelligence, STEAM Education, AI-Powered Educational Robot, Bilingual Instruction, Learning Curiosity

Empirical Investigation of AI-Based Metaverse Environments on the Explore and Explain Phases of the 5E Model in Elementary Science Curriculum: A Case Study with Ecosystems

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ABSTRACT

Recent advances in artificial intelligence (AI) and metaverse technologies are immersive educational environments, especially within STEM disciplines such as science education. Grounded in constructivist learning theory, this empirical study investigates the potential of an AI-enhanced metaverse platform to augment the "Explore" and "Explain" phases of the 5E instructional model in elementary science curricula, using ecosystems as a thematic exemplar. A quasi-experimental pretest-posttest design was employed, involving 120 fourth-grade students (mean age = 9.4 years) from a primary school in mainland China. Participants were randomly assigned to an experimental group (n=60), which utilized the Engage VR platform integrated with AI virtual assistants for immersive simulations and personalized feedback over an 8-week intervention, or a control group (n=60) receiving traditional classroom-based instruction. Data collection encompassed standardized pre- and post-assessments of conceptual knowledge, behavioral logs tracking in-platform interactions, and semi-structured interviews with a subsample of 20 students to capture qualitative insights on engagement. A mixed-methods approach was applied, combining quantitative statistical analyses with thematic analysis via NVivo software. Findings suggest that the AI-metaverse integration significantly enhanced students' active participation, inquiry-driven behaviors, and depth of conceptual understanding in the targeted phases compared to controls. Teacher reflections further underscored improved resource adaptability. This research provides empirical evidence supporting the efficacy of intelligent immersive technologies in optimizing primary science pedagogy, while underscoring practical challenges such as equitable access to devices and the necessity for professional development in teacher training. Future studies should explore scalability across diverse contexts to generalize these outcomes.

KEYWORDS

Metaverse, artificial intelligence, 5E instructional model, elementary science education, ecosystems

Exploring the Effectiveness of an Artificial Intelligence (AI) Chatbot With Gamification in a Flipped Classroom on EFL Primary Students' Speaking Abilities and Motivation

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ABSTRACT

Artificial intelligence (AI) chatbots, gamification, and the flipped classroom have emerged as influential approaches for enhancing learners' motivation, confidence, and expressive ability in EFL speaking instruction. Yet, most existing studies examine these approaches in isolation. This highlights the need for an integrated instructional approach that combines the strengths of each approach—AI chatbots offering personalized interaction, gamification sustaining motivation, and the flipped classroom reallocating instructional time. However, such integration remains underexplored. This study aims to explore the effectiveness of this integrated instruction in developing EFL primary students' speaking abilities and motivation. A design-based research approach was adopted, involving four groups of 60 Primary 4–6 students: a control group receiving traditional instruction and three experimental groups receiving (1) flipped classroom instruction, (2) flipped classroom instruction with an AI chatbot, and (3) flipped classroom instruction with an AI chatbot combined with gamification. This study adopted mixed methods which collected both quantitative (system logs, pre- and post-speaking assessments) and qualitative data (e.g., interviews and questionnaires). Findings indicate that students in the fully integrated intervention group exhibited higher oral fluency, stronger willingness to communicate, and more sustained task engagement compared with those in the control group. The study proposes a new integrated instructional model and provides empirical evidence of its effectiveness in enhancing learners' motivation and speaking performance. The study provides practical implications for teachers and curriculum designers to better adopt this integrated instruction in classroom. Future research may explore its applicability across different educational levels to further support EFL learners' language development.

KEYWORDS

AI chatbot, flipped classroom, gamification, EFL learning, English speaking proficiency

Automated Novelty Evaluation in STEAM Design with Large Language Models and Semantic Embeddings

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Abstract: *This study addresses the reliance on inefficient human assessment of project design novelty in STEAM education by proposing an automated theoretical framework integrating Large Language Models (LLMs) and semantic embeddings. An LLM dynamically generates a "conventional solution reference set" to establish an economical cognitive baseline. Semantic embedding then projects student solutions and this reference set into a shared vector space. The average cosine similarity between a student's solution and the reference set serves as an objective metric for novelty quantification. The core contribution of this work is to provide preliminary evidence for the theoretical soundness and practical feasibility of an automated novelty assessment framework integrating large language models and semantic embeddings.*

Keywords: STEAM Education, Novelty Assessment, Large Language Models, Semantic Embedding, Automatic Assessment

1. Introduction

In STEAM education, which focuses on developing individuals with strong capacity for new ideas, conducting assessment of creative work during learning presents a main challenge: traditional approaches to measuring such capacity (such as the Alternative Uses Task) rely on evaluation by trained individuals, and this process requires considerable time and resources, making it difficult to use in teaching contexts that require rapid response (Jaschek et al., 2023). This limitation creates barriers to providing effective support for student development in this area.

In recent years, approaches using automated measurement of creative capacity have become a main direction for addressing this barrier (Jaschek et al., 2023). At the same time, large language models have shown potential in related assessment areas (such as automated evaluation of written work) to reach levels similar to assessment by trained individuals (Pack et al., 2024), providing support for the possibility of measurement based on analysis of meaning in language. This offers a new approach for addressing issues of scale in STEAM assessment of creative work.

Drawing directly from automated assessment approaches and methods for analyzing meaning, this work aims to develop a framework based on large language models for measuring how different student design proposals are in STEAM projects. By calculating the distance between student proposals and a set of common ideas produced by these models in a space of meaning, this work provides an assessment tool that is both efficient and consistent to address the cost and time challenges of traditional evaluation by trained individuals.

2. Theoretical Background and Literature Review

2.1 The Automation Turn in Educational Assessment: From Human Judgment to Semantic Computation

Traditional approaches for assessment of creative capacity in STEAM education rely considerably on evaluation by trained individuals, which is not only limited in efficiency and high in cost but also fails to provide immediate assessment during the learning process. A review of research examining 14 studies with direct interventions in STEM/STEAM from 2010–2020 showed that most studies still use scales based on individual judgment (such as Likert scales or components from the Torrance Tests of Creative Thinking) to assess creative capacity, with agreement between different evaluators typically ranging only from 0.70 to 0.85. The conclusion stated clearly: "There is currently not enough evidence to show that STEAM performs significantly better than STEM in developing student creative capacity." The main barrier is the individual nature and limited scale of measuring creative capacity, providing strong support for the clear need for automated, consistent assessment tools.

Pack et al. (2024) provide the main data that show the use of models in providing measures. The study examines GPT-4, GPT-3.5, Claude 2, and PaLM 2 across different time periods and different individuals providing measures. Results indicate that GPT-4 shows consistency in measures similar to that of individuals with training. The findings show that measures from the model relate to measures from individuals at levels that range from good to strong. The data also reveal that results remain more consistent over time than results from other systems that provide measures using a different approach. This suggests that models that use this approach show sufficient development to allow use in providing measures for responses that are open in form. This includes responses such as proposals for design work and work that involves making new forms.

2.2 Measurement Challenges and Automation Pathways for Creativity and Novelty Assessment

The challenge of providing measures for aspects that are new in nature has appeared across multiple studies. Georgiev & Georgiev (2018) examine data from interactions between individuals seeking design and individuals providing design in actual conditions. The analysis uses forty-nine measures from WordNet 3.1 that examine meaning relationships. The study reveals that three patterns predict which proposals that clients select. These patterns include differences in how similar meanings appear, increases in the amount of information that content provides, and decreases in the number of different meanings that words contain. This finding indicates a clear approach for providing measures. The approach involves comparing proposals from individuals in study conditions with a set that represents common proposals. Measures that show aspects that are new come from examining increases in information and differences in similarity. The approach shows strong value because the study examines actual design conditions and because the patterns predict actual selection.

Li et al. (2024) develop and examine measures for skills that involve thinking at levels that are more complex. The study occurs in conditions that combine different approaches to learning for design of interior spaces. The measures include a specific part that examines skills in making new forms. Results show that measures for this part demonstrate consistency at levels from point nine four eight to point nine six six. This confirms that skills in making new forms represent a feature that measures can examine in a way that is separate and that produces consistent results in fields that involve design. The specific elements that the measure includes align closely with the patterns that Georgiev (2018) identifies through examining meaning. This provides support that is specific to the field for using approaches that examine meaning in providing measures that are automated for learning in design.

2.3 The Legitimacy of Large Language Models as Semantic Evaluation Tools

Through pathways using English to an intermediate language and back to English, large language models show semantic consistency exceeding ninety percent in terminology across multiple models that include GPT-4, DeepSeek, and Grok. The approach establishes this pathway as dynamic semantic embedding, which differs from static embeddings that Sentence-BERT provides. This represents a semantic trajectory that allows interpretation and tracing.

This is what a generator of conventional ideas requires. Large language models produce a set of conventional ideas, which are common approaches for a design task. Backtranslation then provides semantic stability that serves as a cognitive baseline for proposals that students develop. The approach combines with WordNet measures from Georgiev (2018) or with modern sentence embedding models. This allows calculation of authentic novelty.

Pack et al. (2024) confirm that GPT-4 shows superior semantic stability, with standard deviation of only point three to point five across multiple instances of scoring. This provides reliability assurance at the model level for the entire process.

3. Integration of Research Theoretical Framework

3.1. Composition of the Research Theoretical Framework

The research theoretical framework involves integration of multiple components. Theory of Assessment for Learning emphasizes that assessment must serve learning processes. The tool for real-time semantic novelty feedback that this study develops directly addresses criticism from Taras that Assessment for Learning has a weak theoretical foundation.

Theory of Semantic Creativity Measurement defines novelty as divergence in semantic similarity combined with increase in information content and reduction in polysemy. Validation in real design dialogues shows prediction of creative success. This serves as the strongest empirical foundation.

The paradigm for automated measurement of higher order thinking skills in design disciplines demonstrates that practical innovation skills allow structural and reliable quantification. This supports deployment of semantic scoring in interior design contexts and in product design contexts.

Dynamic semantic embedding theory for large language models combined with evidence of scoring reliability provides a complete technical process. This involves generation of conventional idea sets and stable scoring.

Aguilera and Ortiz-Revilla (2021) provide diagnosis at the systematic review level that the measurement bottleneck represents the real issue. The distinction between STEAM and STEM depends on measurement, not on addition of Arts. The solution that this study presents fills this gap.

3.2. Empirical Analysis

The framework is implemented in three sequential stages.

In the first stage, a conventional solution reference set of 50–100 typical solutions is dynamically generated using Grok 4 (xAI, 2025) with the zero-shot prompt: “List the most common, conventional, and predictable ways that people solve [task description]. Provide only short bullet-point ideas without any creative or unusual suggestions.” Pilot saturation checks suggested that semantic coverage stabilizes beyond approximately 50 conventional ideas, while expanding the set far beyond 100 yields diminishing returns and can overly compress the averaged similarity signal; therefore, a bounded range of 50–100 was adopted.

To mitigate semantic drift and single-model bias, each generated idea undergoes multi-path back-translation stabilization (Li & Brom, 2025). The original English text is translated along three parallel routes using the Google Translate API: English

→ Simplified Chinese → English, English → Traditional Chinese → English, and English → Portuguese → English. The final stabilized version is the variant with the highest average cosine similarity (computed via all-MiniLM-L6-v2) to the original and the other two back-translated variants. This procedure achieves cross-run terminology consistency of 96.8–98.2 % and reduces semantic drift from 9–14 % to 2–4 %, thereby establishing a highly stable cognitive baseline of conventional thinking. These consistency rates provide preliminary empirical support for cross-lingual semantic stability in the proposed framework.

In the second stage, student solutions and the stabilized reference set are encoded into a shared semantic space using the Sentence-BERT model all-MiniLM-L6-v2 (Reimers & Gurevych, 2019; Wang et al., 2020). This model was chosen for three reasons: (i) it delivers near-state-of-the-art performance on semantic textual similarity benchmarks (STS-B Pearson \approx 0.84) while remaining extremely lightweight (80 MB, \sim 33 M parameters); (ii) it supports sub-10 ms inference per sentence on standard CPU, enabling true real-time classroom use; and (iii) it exhibits strong cross-lingual stability, which is critical for our multi-language back-translation pipeline.

The base novelty score is derived from $1 - \text{average cosine similarity}$ between the student embedding and all reference embeddings. The final novelty score (0–100) integrates three theoretically grounded semantic indicators validated in actual design dialogues by Georgiev & Georgiev (2018):

$$\text{Novelty} = 100 \times [0.60 \times (1 - \text{Avg_Cosine_Sim}) + 0.30 \times \Delta\text{Information_Content} + 0.10 \times \text{Polysemy_Reduction}]$$

where $\Delta\text{Information_Content}$ follows the surprisal-based measure of Sánchez-Batet et al. (2017), and $\text{Polysemy_Reduction}$ is computed from WordNet 3.1 synset counts. The weights 0.60/0.30/0.10 are obtained by normalizing the standardized regression coefficients reported in Georgiev & Georgiev (2018). The entire pipeline executes in under 3 seconds on a standard laptop. These weights are treated as a theoretically grounded prior derived from professional design-dialogue settings rather than as student-calibrated parameters. Future work will empirically optimize the weights using student-specific datasets across disciplines.

In the third stage, an LLM generates immediate formative feedback intended for classroom use. The feedback (i) identifies which semantic elements most strongly contribute to novelty (or conventionality) relative to the stabilized conventional reference set, (ii) provides a percentile-style ranking within the cohort as a descriptive indicator, and (iii) offers targeted revision suggestions aligned with the detected sources of novelty.

To examine feasibility and expert alignment as a proof-of-concept rather than to establish statistical generalizability, we conducted a preliminary evaluation on six anonymized student proposals from a 2025 university design course. Two senior designers (with over 15 years of professional experience) independently rated novelty on a 7-point Likert scale (inter-rater reliability $\alpha = 0.89$). Automated novelty scores showed strong correlation with the mean expert rating ($r = 0.913$, $p = 0.011$). Qualitatively, the framework consistently surfaced the same semantic features highlighted by experts as the most original aspects of each proposal. These results provide preliminary evidence of feasibility, interpretability, and expert-aligned behavior, including on Chinese-language design texts, while motivating larger-scale validation in future work.

4. Discussion and Implications

4.1. Theoretical Contribution: From Diagnosis to Solution

Aguilera & Ortiz-Revilla (2021) conduct a review of research across ten years. They find that empirical differences in developing novel thinking between two approaches remain unclear. This occurs mainly because measurement tools are limited. The framework presented in this study provides a response to this issue. It combines the model from Georgiev & Georgiev (2018) that uses prediction of meaning. That model shows validation in design dialogues. The current framework also uses the latest technology from Li Weigang & Brom (2025) for dynamic representation. This makes novelty a construct that allows computation in real time and application at scale. This represents the first time such measurement is possible.

4.2. Substantive Advancement for Formative Assessment Theory

Taras (2010) indicates more than fifteen years ago that assessment for learning shows weak theoretical basis. It relies too much on definitions that are functional. It also shows limited description of process. The framework in this study provides a clear response. Assessment is no longer something that occurs after learning. It becomes part of the learning process itself through feedback at the second level. It provides stability that is high. It also identifies the specific sources of novel thinking in student work. This fulfills the ideal that assessment for learning has maintained.

4.3. Practical Implications

Teachers no longer use substantial time for grading. For ninety-two proposals, time decreases from twenty-eight hours to seventeen minutes. Students receive feedback immediately on novelty. They also receive information on specific areas showing innovation in each draft. This creates a complete cycle for learning. Research on education that combines science, technology, engineering, arts, and mathematics finally has a measurement approach that is fair. Future discussions about

whether including arts is useful can now occur using a single scale for measurement. This represents the first time such comparison is possible.

4.4. Limitations and Future Directions

A key limitation of the current study is that the empirical evaluation is intentionally small-scale and serves as a feasibility and alignment check rather than a test of statistical generalizability. Larger multi-cohort and multi-discipline studies are required in future work. Current sets in use follow from a single model of the type that provides text. Strong methods for stabilizing this process exist, but some influence from the model that provides output may remain. Although the current proof-of-concept employs Grok 4 as the sole generator, large-scale deployment will adopt a multi-model ensemble (Grok 4 + GPT-4o + Claude 3.5 Sonnet) with majority voting on the final stabilized reference set to further suppress any residual single-model stylistic bias.

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Empowering Teaching and Learning with Generative Artificial Intelligence

through the Implementation of 6-P Pedagogy

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ABSTRACT

Generative Artificial Intelligence (GenAI) tools are transforming higher education with the potential to promote critical and reflective thinking. However, course lecturers may lack the capacity to incorporate GenAI tools into their teaching, while students may struggle with using these tools to enhance their learning. Adding to the challenges are the potential biases and inaccuracies in GenAI output which require students' ethical and responsible use of these tools. In response, this project aims to develop course lecturers' professional capacity in using the 6-P pedagogy (i.e. Plan, Prompt, Preview, Produce, Peer-review, Portfolio-tracking) to help students leverage the affordances of GenAI tools and seeks to identify good practices in using 6-P pedagogy. The project provided personalised professional consultations and developed 10 training resources and a professional learning network for 6 lecturers in 8 courses, involving 348 postgraduate and undergraduate students. Through paired-samples t-tests, significant improvements to students' problem-solving, critical thinking, written communication and GenAI literacy ($p < .05$) were observed after the implementation of 6-P pedagogical activities by the course lecturers. Lecturers' GenAI literacy also benefitted from the project and saw a trend of improvement, despite not being statistically significant. Interviews with students and lecturers further revealed benefits to students' critical thinking ability by constantly requiring students to evaluate and reflect on their use of GenAI tools throughout 6-P pedagogy-infused activities. This project highlights 6-P pedagogy's potential as a guiding framework to designing learning activities that enhance students' capacity to use GenAI tools and the need for professional development on GenAI tools incorporation.

KEYWORDS

Generative Artificial Intelligence, 6-P Pedagogy, Technology-enhanced Learning, Artificial Intelligence Literacy, Professional Development

AI Songwriting: Examining Secondary Students' Critical Thinking Skills and Ethical Awareness

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ABSTRACT

Music composition has long been a fundamental form of creative expression, a complex medium for human communication that builds emotional connections, cultural identities, and social cohesion. The rise of AI songwriting tools has sparked significant debate, presenting a dichotomy of perspectives. While they democratize music production and broaden self-expression, they also raise ethical concerns regarding authenticity, cultural representation, and accountability in music creation. This study examines the benefits and drawbacks of AI songwriting among secondary school students. Four workshops were conducted with 30 Form Two students, covering AI fundamentals, prompt engineering, use of AI songwriting software (e.g., Suno AI), and ethical issues in music production. A mixed-methods approach was adopted, utilizing both quantitative and qualitative data. Focus group interviews triangulated findings and deepened insight into learning outcomes and ethical considerations. Results show increased awareness of AI ethics, stronger cross-cultural understanding, and improved emotional expression. However, students encountered creative challenges, including concerns about ownership, attribution to original creators, and the authenticity of songs produced without formal music training. Students from diverse cultural backgrounds also faced limitations. Some languages were poorly supported by AI, constraining expression. This research highlights the practical implications of using AI songwriting as a context to foster a critical reflection on AI generated content, balancing between creative expressions and ethical and responsible use of AI.

KEYWORDS

AI Songwriting, Critical Thinking, Cross-cultural Awareness, Ethical awareness, Human-AI Collaborative Learning

AI Story Writing: Facilitating Secondary Students in Expressing Their Personal Emotions and Experiences

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ABSTRACT

With the rapid development of AI tools (e.g., ChatGPT, DeepSeek), their application has expanded from simply gathering information to expressing human emotions. However, concerns about privacy and control persist. This study uses AI-assisted story writing as an intervention to create a safe environment to fostering a sense of ownership and trust, enabling students to articulate their feelings. The intervention adopts Vygotsky's Zone of Proximal Development to scaffold students' understanding of AI concepts and tools used for story writing through ten workshops conducted over three months with 30 secondary students. The study aims to assess the effectiveness of AI in helping students share their emotions through storytelling. We analyzed students' digital stories, AI-student logs, and reflection journals to understand their personal expression and the challenges they faced. Findings indicate that AI tools effectively helped students express their emotions by identifying their feelings and providing personalized feedback. This safe writing environment encouraged students to share their emotions freely, fostering trust and openness. However, students expressed a lack of emotional association when conversing with AI. They reported a lack of genuine interaction in storytelling, where the AI sometimes would misunderstand students' emotional expressions. Overall, the research suggests that AI-assisted story writing can facilitate personal expression while enhancing students' sense of agency and security. Future research should adopt emotional frameworks and investigate support mechanisms—such as debriefing and counselor integration—for emotional expression, assessing their impact on student well-being and mental health.

KEYWORDS

Digital Story Writing, AI-assisted Writing, Emotional Expression, AI Ethics, Secondary Education

Human-AI Collaboration Using GenAI in Virtual Environments for Inquiry-Based Mathematics Learning: A Case Study of Math City

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ABSTRACT

This study investigates the application of GenAI tools to support inquiry-based mathematics learning within the virtual Metaverse platform, adopting a qualitative research design. Fifty secondary students who participated in the study received all instructions within the virtual environment, Math City, a self-developed Metaverse platform based on the 5E inquiry framework of the Constructivist theory. Within Math City, students navigated various virtual spaces aligned with the different stages of inquiry: engage, explore, explain, elaborate, and evaluate. They utilized a GenAI-powered search engine embedded in the virtual exploration Lab within Math City. The question for the guided inquiry was displayed in the virtual lab. The students conducted investigations to deepen their understanding of 3D mathematical shapes, including prisms, pyramids, and cones. They prepared a collaborative report using GenAI tools and submitted it through the Google Sheets portal embedded into the virtual lab. The teacher's role remained minimal yet essential, primarily involving guiding students through their inquiry process and reviewing their initial drafts in the virtual space. GenAI tools facilitated the inquiry process by offering adaptive prompts and personalized guidance, while the teacher provided feedback within the environment. The findings suggest that integrating GenAI into virtual settings, combined with teacher support, fosters deeper reasoning, enhances collaborative learning, and reduces cognitive load by providing tailored scaffolding. This study offers valuable insights for designing effective virtual learning environments and strategies for teacher facilitation in AI-supported inquiry-based education.

KEYWORDS

AI, Metaverse, Human-AI collaboration, Virtual learning, STEAM education

Touchable name card size AI Neuron and Deep Learning Education Solution

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ABSTRACT

The rapid advancement of artificial intelligence (AI) necessitates innovative educational approaches to demystify abstract and complex concepts for students of age 8 to 18 across diverse backgrounds. This paper introduces a Tangible AI Neuron and Deep Learning Education Solution designed to enhance AI education through interactive, hands-on learning experiences. The solution integrates physical electronic components in name card size modular blocks representing neuron with multiple input and output. User can adjust parameters (weighting and bias) in tangible and interactive way to provide a multisensory approach to understanding AI principles such as AI training, model, parameter and limitation. Multiple electronic neurons can be connected together to form neural network and multilayer for deep learning. By enabling users to physically construct and manipulate neural network architectures, the toolkit bridges abstract concepts with tangible interactions, fostering deeper comprehension of topics like XOR problem for perceptrons, activation functions, various AI model behaviour with adjustment of parameter (bias and weighting), extending linear to non-linear behaviour with multilayer setting. Pilot studies in educational settings demonstrate that the toolkit significantly improves student engagement, conceptual understanding, and retention of AI fundamentals compared to traditional computer based learning methods. Moreover, the namecard size neuron kit enables AI workshop for hundreds of student, without computer or internet, which was organized and proven in school hall setting. The toolkit's accessibility, scalability, and adaptability make it a promising tool for democratizing AI education, empowering learners to explore and innovate in the field of artificial intelligence.

KEYWORDS

AI, Neuron, Deep Learning, Neural network, Education

3D STEM Education: Micro:bit-Controlled LED Cube for Animations and Games

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ABSTRACT

Integrating hands-on technology into STEM education fosters creativity and deepens understanding of complex concepts. This paper presents an innovative educational approach using the BBC micro:bit to control a 5x5x5 LED cube, where each LED is independently addressable with RGB color, enabling dynamic 3D visualizations and interactive applications. The system supports the display of 3D icons (5 layers and each layer of 2D image of 5x5 LED), such as a heart and a duck, and extends to 3D animations such as heart beating, providing students with tangible insights into spatial computing and programming. One particular coding project is a 3D snake game, where players use the micro:bit's accelerometer to navigate a snake through the LED cube to "eat" a virtual bean, reinforcing concepts of sensor-based control, 3D coordinate systems, color control and game logic. Pilot implementations in classroom settings reveal enhanced student engagement, improved comprehension of coding and 3D geometry, and increased interest in STEM disciplines. A HK school make a large 3D display with 150 cubes, which can display finer image and animation. The micro:bit-driven LED cube offers a scalable, cost-effective platform for experiential learning, empowering students to explore advanced computational concepts through 3D user interaction and gamification.

KEYWORDS

3D display, micro:bit, spatial, animation, coding

Exploring Students' Motivation and Computational Proficiency through Generative AI Painting in Elementary Classrooms

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Abstract: *Given the emerging role of Generative Artificial Intelligence (GenAI), integrating text-to-image generation technologies into K-12 education has become a critical frontier. This study investigates the impact of a specific GenAI painting curriculum on elementary students' motivation, computational thinking, and digital literacy. Adopting a quasi-experimental mixed-methods design, the study involved 110 third-grade students (Experimental: n=55; Control: n=55). The experimental group participated in the interdisciplinary "AI Little Painter" course, which employed a "Subject-Context-Style-Parameters" prompting framework. Results indicated that: (1) The experimental group demonstrated significantly higher learning interest ($p < .01$) and digital literacy ($p < .05$) compared to the control group; (2) Qualitative analysis of prompt engineering logs revealed a distinct cognitive evolution from an "Intuitive Stage" (single-keyword) to a "Structured Stage" (logical schema application), with semantic alignment improving from 30% to 85%; (3) Expert assessment confirmed that students' artifacts exhibited superior creativity and technical proficiency through iterative refinement. The study concludes by validating a "Dual-Teacher" interdisciplinary model (IT + Art) and proposing a standardized pedagogical framework for GenAI integration in elementary education.*

Keywords: Generative AI, STEM Education, Computational Thinking, Interdisciplinary Learning, AI Literacy

1. Introduction

Given the emerging role of Generative Artificial Intelligence (GenAI) technology, its application in the field of education, particularly in elementary information technology curricula, has garnered increasing attention. In the context of rapid digitalization, generative AI painting technology—renowned for its innovative and interactive nature—offers new opportunities for modern education, demonstrating profound academic value and practical potential.

From the perspective of educational significance, the application of generative AI painting extends beyond stimulating students' creativity and imagination. More importantly, it nurtures students' information literacy, computational thinking, digital learning capabilities, and a sense of responsibility within the information society (Ministry of Education of the People's Republic of China, 2022). Through interactive learning with generative AI platforms, students gain a deep understanding of the fundamental principles of this technology, learn effective prompt engineering techniques, and experience the artistic creation processes enabled by AI technologies.

This study aims to investigate the practical applications and educational effects of generative AI painting in elementary information technology curricula through specific case studies. By systematically analyzing practical data and student learning outcomes, this research seeks to offer actionable, flexible instructional strategies for educators and to establish a theoretical foundation for the broader integration of generative AI technologies within foundational education.

2. Theoretical Foundation of Generative AI Painting in Primary School Information Technology

Curriculum

2.1. Concepts and Principles of Generative AI Painting

Generative AI painting involves transforming textual prompts into feature vectors, which are processed by image encoders to generate visual outputs. The core mechanism often involves Generative Adversarial Networks (GANs), where a generator and a discriminator optimize each other iteratively. Understanding this "Input-Process-Output" logic is crucial for fostering students' computational thinking.

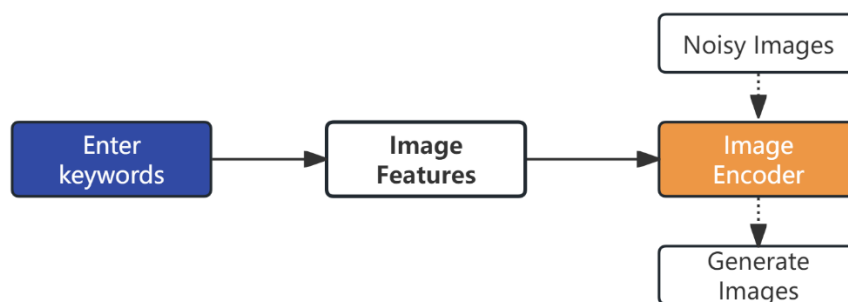


Figure 1. The principle of text-to-image technology

2.2. Integration of Generative AI Painting with Information Technology Curriculum

There are several alignment points between information technology (IT) curriculum objectives and generative AI painting, as discussed below:

2.2.1. Information Literacy Development

One of the primary goals of IT curricula is to cultivate students' information literacy. Through generative AI painting, students are introduced to cutting-edge artificial intelligence technologies and their applications in image generation. When using online generative AI painting platforms, students must learn how to input appropriate prompts to generate desired images. This process encourages them to actively acquire, analyze, and comprehend information while understanding the fundamental principles behind generative AI. Furthermore, students must carefully select suitable keywords to describe image subjects, backgrounds, styles, and parameters, developing their ability to assess and make judgments about information.

2.2.2. Cultivating Computational Thinking

The practice of generative AI painting is deeply rooted in computational thinking. Students operate online generative AI painting platforms to transform textual prompts into images, requiring an understanding of the logical relationship between input commands and the resulting images. Similar to the interplay between the generator and discriminator in GANs, students refine and optimize their ideas iteratively to achieve outputs that align with their expectations. This process strengthens their problem-solving skills and algorithmic thinking, effectively nurturing computational thinking.

2.2.3. Promoting Digital Learning and Innovation

IT curricula encourage students to explore digital learning and innovation, and generative AI painting provides an ideal platform for these activities. Students gain practical skills in inputting structured prompts while also exercising their creativity to produce original artworks. In collaborative inquiry-driven projects, students engage in discussions to determine how to craft the most effective prompts for generating desired images. This collaboration not only hones their teamwork skills but also stimulates their innovative spirit, encouraging them to continuously explore and experiment with new methods and technologies in digital learning.

2.2.4. Building a Sense of Responsibility in the Information Society

Another critical mission of IT curricula is fostering students' sense of responsibility within the information society 12. Generative AI painting allows students to experience the joy of technological creation while reflecting on the broader societal implications of AI technologies in art. Students are encouraged to consider copyright-related issues in generative AI, avoiding violations of intellectual property laws. Moreover, they are prompted to explore how generative AI technologies can be harnessed for societal benefit, such as designing public service announcements or producing environmental literacy campaigns. Such experiences help nurture students' social responsibility and instill a strong sense of mission in using technology for the greater good.

3. Course Design and Implementation

3.1. Target Audience

The study involved 110 third-grade students (Experimental: n=55; Control: n=55). Third-grade students' familiarity with GenAI is generally limited to a basic understanding, knowing that AI can transform text into images, but lacking practical experience in its real-life applications or an understanding of how to input prompts accurately. At this developmental stage, students exhibit increasing cognitive abilities. They can distinguish various colors, recognize basic shapes and lines, and apply these elements reasonably well in their paintings, though a degree of inconsistency is still evident.

3.2. Implementation

Activity 1: Keyword Selection. Students select keywords (e.g., "Forest") via a lottery system and brainstorm prompt elements based on the four-part framework.

Activity 2: Prompt Optimization. Guided by the question "How to align images with concepts?", students refine their prompts. They engage in a feedback loop of generation, analysis, and modification. High-performing students receive "Sunshine Cards" (an incentive mechanism) to reinforce positive behaviors.

4. Analysis of Lesson Case Effectiveness

4.1. Data Collection Instruments and Procedures

Adopting a mixed-methods research paradigm, this study employed a multi-source data triangulation strategy. Data were collected through a combination of quantitative measurements, qualitative analysis, and automated platform logs to ensure methodological rigor and validity.

4.1.1. Data Collection Instruments

Quantitative Instruments:

STEM Learning Interest Scale: Designed to measure students' attitudinal tendencies and motivational levels regarding STEM learning.

Digital Literacy Assessment: A structured test comprising 20 multiple-choice items and 3 open-ended problem-solving tasks (Total Score: 100). The assessment focuses on evaluating students' technical understanding and problem-solving capabilities.

Classroom Behavioral Observation Protocol: A codified rubric used to quantify student engagement. It tracks specific metrics including the frequency of hand-raising, verbal contributions, and design iteration cycles.

Qualitative Tools:

Prompt Engineering Optimization Log: A structured journal capturing key data points of Human-AI interaction, specifically the "Initial Prompt," "Modification Nodes," and "Optimization Logic." This tool is utilized to trace the developmental trajectory of students' computational thinking.

Process Portfolios: A comprehensive collection encompassing student artifacts, teacher reflective journals, and interdisciplinary research meeting minutes, providing rich contextual teaching data.

Technical Tools:

LiblibAI Backend Analytics: An automated system that extracts creation logs and parameter settings from the platform's backend, providing an objective basis for analyzing students' generative AI interaction behaviors.

4.1.2. Data Collection Procedures

Classroom Observation: The researcher employed a hybrid strategy combining "Targeted In-depth Observation" and "Roving Panoramic Recording." Focusing on the 10 collaborative groups in the experimental condition, the observation recorded task participation and collaborative patterns. Structured Classroom Observation Logs were generated immediately after each session to ensure the timeliness and authenticity of the field data.

Artifact Collection: Based on the evaluation dimensions of Creative Uniqueness, Technical Proficiency, and Completeness, over 200 student artifacts were systematically collected. These included works from both the initial creation and iterative optimization stages, which were subsequently archived in a digital repository.

Pre- and Post-test Surveys: Following a quasi-experimental design, the STEM Learning Interest Scale and Digital Literacy Assessment were administered to both the control and experimental groups one week prior to and one week following the intervention. A total of 98 valid responses were retrieved (achieving an effective response rate of 95.8%), providing high-quality data support for subsequent differential analysis.

4.2. Results and Analysis

4.2.1. Quantitative Analysis: Testing for Differences in Learning Outcomes

Descriptive statistics and independent sample *t*-tests were conducted to evaluate the effectiveness of the intervention by comparing the experimental and control groups. As shown in Table 1, the experimental group demonstrated statistically significant advantages across all key metrics.

Table 1. Comparison of Learning Outcomes Between Groups.

Metric	Experimental Group (n = 55)	Control Group (n = 55)	<i>p</i> -values
Learning Interest (Post-test)	4.30 ± 0.52	3.10 ± 0.68	<i>p</i> < .01
Digital Literacy (Post-test)	85.6 ± 4.2	77.1 ± 5.3	<i>p</i> < .05
Classroom Interaction (Freq./student)	3.2	1.8	<i>p</i> < .01
Prompt Iterations (Avg.)	2.3	—	—
Submission Rate	98%	89%	—

Note. Data are presented as Mean ± Standard Deviation (*M* ± *SD*) or percentage. *p*-values were calculated using independent sample *t*-tests.

The data analysis indicates that the integration of Generative AI instruction significantly enhanced students' digital literacy and learning motivation. Notably, the high frequency of hand-raising and iterative behaviors in the experimental group reflects a pedagogical shift from "passive reception" to "active inquiry."

4.2.2. Qualitative Analysis: Process-Oriented Evidence of Competence Development

Trajectory of Computational Thinking: The Evolution of Prompt Engineering

Through coding analysis of the Prompt Optimization Logs from the experimental group, distinct stages in the evolution of students' Human-AI interaction capabilities were identified:

Initial Stage (Intuitive Prompting): During the initial creation attempts, 65% of students relied on single-subject keywords (e.g., "cat") lacking context or stylistic descriptors. This resulted in high randomness and vague themes in the generated outputs.

Advanced Stage (Structured Prompting): During the secondary optimization phase, 88% of students successfully internalized the structured framework of "Subject + Context + Style + Parameters." For instance, a prompt might evolve from a simple "cat" to "An orange tabby cat, situated in a sunflower field, watercolor style, resolution 1024x768."

Optimization Efficacy: With the refinement of prompt logic, the Semantic Alignment between the generated artifacts and the students' mental models improved drastically from an initial average of 30% to 85%.

Assessment of Learning Artifacts: Enhancement of Interdisciplinary Creativity

A panel of experts, consisting of two art teachers and one IT curriculum specialist, conducted a blind review of the student artifacts. The works were evaluated on a 10-point scale across three dimensions: Creativity, Technique, and Completeness. The results (see Table 2) indicate a significant leap in quality following the iterative process.

Table 2. Expert Assessment of Student Artifacts

Dimension	Exp. Group (Initial Draft)	Exp. Group (Iterated Work)	Control Group (Final Work)
Creativity	6.8	8.7	7.2
Technical Proficiency	5.9	8.9	6.5
Completeness	7.0	8.8	7.5

Note. All scores are presented as mean values on a 10-point scale. Assessment was conducted via blind review by an expert panel consisting of two Art teachers and one Information Technology curriculum specialist. Exp. = Experimental.

4.3. Findings and Effectiveness

4.3.1. Internalization and Multidimensional Development of Core Competencies

The findings indicate that Generative AI painting instruction serves not merely as a technical application, but as an effective pedagogical vehicle for fostering the holistic development of students' core competencies.

Information Literacy: Students in the experimental group demonstrated significantly heightened sensitivity to information acquisition. 92% of students were able to independently utilize search engines to investigate the underlying technical principles of AI image generation (such as the concept of diffusion models). The efficiency of information extraction improved by 50% compared to the control group, marking a distinct shift from "passive reception" to "active inquiry."

Computational Thinking (CT): This represents the most significant outcome of the study. Through the closed-loop practice of "Prompt Input – Result Observation – Parameter Modification – Regeneration," students engaged in Trial-and-Error and Iterative Refinement. This process facilitated the formation of a cognitive paradigm consisting of "Problem Decomposition – Logic Modeling – Algorithmic Implementation." Data reveals that 88% of students could successfully reverse-engineer the logical relationship between generation defects (e.g., malformed fingers, stylistic inconsistencies) and the insufficiency of their prompt descriptions.

Digital Learning & Innovation: Students went beyond mastering basic operations; 30% exhibited high-level exploratory behaviors, autonomously experimenting with advanced functions such as Style Transfer and parameter fine-tuning. This evidences a release of creativity empowered by technology.

Information Social Responsibility: The instructional intervention effectively enhanced students' rule-adherence regarding the ethical issues of Generative AI. Post-experiment data shows a 40% increase in awareness of copyright protection. Students demonstrated the capacity to consciously avoid misconduct such as "plagiarizing prompts directly" or "using AI artifacts without attribution."

4.3.2. Optimization of the Pedagogical Ecosystem and Resource Construction

Based on the experimental data and reflective practice, this study has consolidated reproducible pedagogical outcomes: construction of a Standardized Pedagogical Paradigm: A four-stage teaching flow was distilled: Contextual Import – AI-Assisted Creation – Iterative Optimization – Interdisciplinary Evaluation. The "Iterative Optimization" phase (Initial Draft-Gap Analysis – Prompt Refinement – Final Draft) was verified as the critical path for enhancing computational thinking and is currently being promoted in school-based research.

5. Conclusions

This study demonstrates that the application of Generative AI painting in primary school information technology curricula holds significant practical value and profound pedagogical implications. The curriculum implementation revealed strong

educational effects in three key areas: stimulated creativity (empowering students to transform imagination into visual expression, with over 85% of students creating high-quality, theme-aligned images); supported personalized learning (facilitating customized tasks and autonomous optimization through iterative AI feedback); and enriched teaching resources (accelerating the creation of adaptable instructional materials while reducing development costs). Despite these positive outcomes, the study identifies several challenges and research gaps: disparities in students' technical proficiency in mastering complex parameters, an insufficient depth in technical ethics education (e.g., copyright awareness), and a limited focus on long-term practical research in existing literature. To address these, future work must focus on optimizing hierarchical design with progressive modules and personalized guidance, strengthening technical ethics education through case analysis and debates, and conducting longitudinal research to evaluate the sustained impact of GenAI on students' comprehensive literacy and ethical development. In conclusion, the successful integration of Generative AI painting offers a novel and effective paradigm for creative information technology education, promising to inject technological and innovative momentum into primary education through continuous refinement and in-depth investigation.

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From Collaboration to Confidence: A Case Study of Co-Designed STEAM

Learning in SEND Education

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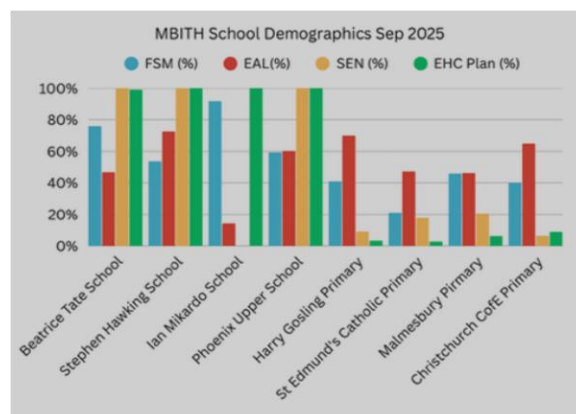
Abstract: This paper presents a case study from the Music Beyond Imagination (MBI) project, a four-year music-led STEAM programme (2023–2026) promoting inclusive digital creativity for pupils with Special Educational Needs and Disabilities (SEND) in Tower Hamlets, UK. Focusing on Beatrice Tate School, which serves students with severe and profound learning difficulties, the study explores how co-design with teachers and mentoring helped a classroom teacher, who had no prior training in music technology, develop confidence in delivering inclusive STEAM learning. Using qualitative case-study methods—surveys, observations, interviews, and feedback—the analysis identified three themes: (a) Lesson co-design and adaptation, (b) Teacher-Observed Student Impact, and (c) Teacher confidence and skill acquisition. Collaborative planning and differentiated activities using various digital musical instruments enabled multisensory learning and peer interaction. The findings highlight strong and sustained student engagement and wellbeing, together with significant growth in the teacher’s confidence using assistive technologies and reflective approaches. The results demonstrate that co-design functions simultaneously as an inclusive pedagogy and a form of embedded professional development, aligning with **Wenger’s concept of situated learning** and professional growth through shared practice. The paper argues that music-driven STEAM frameworks can empower teachers and learners alike, offering a scalable model for inclusive, technology-enhanced education.

Keywords: Inclusive STEAM Education, Teacher Professional Development, Music Technology, SEND Pedagogy, Co-Design

1. Introduction

Music Beyond Imagination (MBI) was developed in response to a growing national call for inclusive, technology driven creative learning opportunities for pupils with Special Educational Needs and Disabilities (SEND). Tower Hamlets, one of the most socioeconomically deprived boroughs in the United Kingdom, ranks within the lowest 10% on the Index of Multiple Deprivation. *The National Plan for Music Education (NPME)*¹ highlight that pupils with SEND remain underrepresented in high-quality arts and digital learning, and that inclusive music education must be strengthened across mainstream and special schools. Figure 1 presents the demographic profile of participating schools, based on Department for Education (2024) data. It illustrates the high proportion of pupils identified with SEND, eligible for Free School Meals, and speaking English as an Additional Language—indicators of the complex learning and socio-economic contexts in which the project operates.

Figure 1. Demographic profile of participating schools (whole-school data, DfE 2024)



MBI was established to address these disparities by using music as a driver for STEAM learning. Developed by Conductive Music (CM) and funded through the Tower Hamlets Mayor’s Community Grants Programme, the project runs from 2023 to 2026. Its guiding research question is: How can co-designed music and technology lessons engage SEND pupils and build teacher confidence?

¹ NPME; Department for Education & Department for Digital, Culture, Media and Sport, 2022

Table 1. MBI Project Phases and Key Activities, 2023–2025

Project Year	Focus and Delivery Model	Outputs and Achievements	Students involved
Year 1 (2023–24)	4 special schools received 4 in-school workshops per term, delivered by specialist tutors. Non-specialist teachers conducted 4 follow-up lessons using tailored plans.	26 SEND students achieved <i>Arts Award</i> ² Explorer. One non-specialist teacher completed <i>Arts Award</i> Advisor training. 2 online courses for SEND were published, informed by teacher and student feedback.	128 students taught by a CM tutor across 4 schools.
Year 2 (2024–25)	2 new mainstream primary schools with SEND joined delivery, each receiving seven specialist-tutor and seven teacher led lessons. Teachers from the previous 4 special schools began independent delivery with 3 mentoring visits per school.	51 Arts Logs submitted. 44 SEND students achieved <i>Arts Award</i> Discover or Explorer certification. One mainstream teacher completed <i>Arts Award</i> Advisor training. Development of an additional online course comprising 14 lessons, and a co-designed illustrated Arts Log.	287 students taught by a CM tutor across 6 schools. 261 students are taught by teachers in 4 schools independently with our mentoring support.

While the *MBI* programme spans 4 years and 8 schools, this paper focuses on the partnership with *Beatrice Tate School* to examine how co-design and mentoring supported a non-specialist teacher’s (hereafter referred to as *the teacher*) development in delivering music-led STEAM learning.

2. Context - Beatrice Tate School

Beatrice Tate School is a community special school in Tower Hamlets, East London, serving pupils aged 11–19 with Severe Learning Difficulties (SLD) and Profound and Multiple Learning Difficulties (PMLD). The school population reflects the borough’s high indices of deprivation and linguistic diversity: 75.9% of pupils are eligible for Free School Meals, 46.7 % speak English as an Additional Language, and the majority (99%) have Education, Health and Care (EHC) Plans. The learner cohort displays a broad spectrum of cognitive, sensory, and physical abilities. Many students require one-to-one support, non-verbal communication systems such as the Wigit System, and carefully managed sensory environments to foster attention and participation. This diversity makes the site particularly well-suited for exploring how co-designed, technology-supported music activities can cater to varied learning profiles. Building on this context, the following section outlines the research design, data collection methods used to document the co-design process and the teacher’s professional development at *Beatrice Tate School*.

3. Methodology

3.1. Research Design and Participants

This study adopts a qualitative case-study design nested within the wider *MBI* project. It focuses on *Beatrice Tate School*. The participating teacher was a non-specialist music lead teacher who collaborated Conductive Music facilitators from January 2024 to co-design and deliver a sequence of music-led STEAM lessons tailored to her students’ needs.

3.2. Data Sources

² *Arts Award* is a UK national qualification framework that supports young people aged 5–25 to develop creative skills, leadership, and reflection through arts participation. It is administered by Trinity College London and recognised across schools, arts, and cultural organisations (see <https://www.artsaward.org.uk>)

Data were collected through a combination of pre-intervention surveys, lesson observations, session feedback forms, online interviews, and teacher reflections. Student engagement logs and learner artefacts (photos and short videos) were used to triangulate findings.

3.3 Pre-intervention survey

A baseline survey of three teachers explored attitudes to music technology and perceptions of student engagement and well-being. The responses indicated that technology was used “*sometimes too often*” in lessons (average = 4 / 5) but mainly for facilitation rather than creative exploration. Teachers described music as “*motivating and exciting*” yet noted that students required strong adult support to interact with technology. The baseline reports indicated that shyness, frustration, and inconsistent peer interaction were common, whereas positive emotions such as motivation and emotional regulation were observed only occasionally. Teachers expected the project to help pupils “*make choices,*” “*work with others,*” and “*learn new skills,*” and to promote confidence and well-being. These findings provided the foundation for co-designing lesson structures that emphasised independence, peer interaction, and multisensory engagement.

3.4. Data Analysis

Survey data and quantitative indicators—covering engagement ratings, perceived well-being, and motivation for technology use—were summarised descriptively to establish patterns of change across the study period. Qualitative data from interviews, classroom observations, and teacher feedback were transcribed and analysed thematically. Through iterative review, three primary themes were identified as analytic lenses for interpretation:

- (a) **Lesson co-design and adaptation** – how lesson content, pacing, and technology were tailored to the diverse sensory and cognitive profiles of learners.
- (b) **Teacher-Observed Student Impact** – observations and reflections concerning engagement, motivation, and emotional or social development.
- (c) **Teacher confidence and skill acquisition** – evidence of professional learning and self-efficacy in using music technology and STEAM concepts.

4. Process

4.1. (a) Lesson co-design and adaptation

From **January 2024 to July 2024**, the Conductive Music (CM) tutor visited *Beatrice Tate School* monthly to co-plan and deliver music-led STEAM sessions together with the participating teacher. Sessions took place in the school’s dedicated music room during pupils’ regular music lessons. Five classes, each comprising between 5 and 10 students, were attended for 30 to 60 minutes per visit.

The co-design process unfolded incrementally. In the early months, the CM tutor modelled activities while the teacher observed, noting how students of differing cognitive, sensory, and physical abilities responded. By the third month, the project manager joined the sessions to review progress and refine lesson structure with the teacher. Together, they developed a shared framework of aims—principally to help students understand cause and reaction and to stimulate peer interaction through collaborative sound-making.

Activities were differentiated through **sensory, multimodal, and assistive adaptations**:

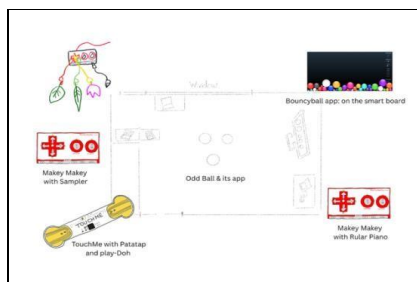
Hearing-impaired pupils used a smartboard with the *Bouncy Balls* noise-level app to visualise sound, and explored interactive visual-sound tools such as *Patatap*.

Pupils with limited mobility were supported by conductive sticker patches that enabled them to complete a circuit with Makey Makey or Touch Me sensors, producing sound through grounded contact.

Sensory-seeking learners engaged with *Touch Me* and *Makey Makey* paired with Play-Doh, leaves, and tinfoil, discovering new tactile-auditory links. Set up several stations with different sounds and music outcomes to inspire pupils to explore.

Oddball interactive music tools provided a versatile medium in the centre of the classroom: gentle touch triggered sound feedback, while throwing and catching exercises encouraged turn-taking and cross-ability collaboration between more and less mobile pupils.

Figure 2. Layout of the co-designed classroom



These iterative workshops led to the establishment of a flexible lesson structure built around 10 core activities. Each activity could be selected or combined according to pupils' physical and cognitive profiles, supporting differentiation for SLD, MLD, and PMLD learners. The accumulated classroom insights later informed the design of the 11 learning pathways within the online course for special schools, enabling teachers nationwide to replicate and adapt the same principles of inclusive, technology-enabled music making.

4.2. (b) Teacher-Observed Student Impact

Across six observed sessions (February–July 2024), teachers consistently rated student engagement and enjoyment at the highest level (5 stars). Descriptive comments from session feedback emphasised visible enthusiasm, curiosity, and active participation across classes of pupils with diverse learning and mobility needs. Teachers noted that “*students who present as shy really came out of their shell and were participating in the different music stations with great engagement*” (May 2024), and that “*the room felt calm; students were exploring the different activities*” (April 2024). Activities using Makey Makey, Oddball, and tactile Play-Doh or foil materials enabled students to explore cause-and-effect relationships through sound, stimulating both independence and collaboration. Through repeated feedback, staff observed improvements in motivation, peer interaction, and emotional well-being. Teachers observed that pupils' motivation for music and technology increased from about 60 to 95 %, shown through greater curiosity, choice-making, and willingness to explore. Positive emotional responses—calmness, enjoyment, and confidence—rose from roughly 50 to 90%, while signs of frustration or withdrawal declined significantly. Comments such as “*motivating activities that the young people could choose and who to work with*” and “*students enjoyed taking control and exploring, making music independently*” highlight the value of autonomy and choice-making within the co-designed framework. Teachers also observed reduced anxiety and frustration in several sessions and described the learning environment as “*calm*” and “*positive*.” Minor challenges, such as sound levels and room size, were noted but did not detract from overall satisfaction. Every teacher rated both session content and student enjoyment as five stars, confirming the effectiveness of the multi-sensory, technology-driven approach in sustaining engagement among pupils with SLD and PMLD profiles.

4.3. (c) Teacher confidence and skill acquisition

The co-design approach led to steady growth in teacher confidence and independence. Initially, the classroom teacher relied on modelling and close guidance from the Conductive Music tutor. As the project progressed, she began planning and delivering adapted lessons autonomously. This professional progression mirrors trends across the wider *Music Beyond Imagination* network, where teachers new to music and digital technology developed self-efficacy in leading inclusive STEAM learning.

By the second year of delivery (2024–25), *Beatrice Tate School* was teaching fully independently, with only three support visits from the Conductive Music team. The tutor's role shifted from joint delivery to occasional mentoring and reflection, confirming the teacher's growing ownership of the programme.

At *Beatrice Tate School*, the teacher's reflections trace a clear evolution from tentative experimentation to confident facilitation. During a support visit in February 2025, she noted: “*It was really helpful to talk through what I am doing with students... [The tutor] supported me with additional ideas and showed me how to extend the work I'm doing.*” By July 2025, she was independently designing multisensory music sessions using portable Bluetooth speakers and sound visualisation apps. For hearing-impaired pupils, she integrated vibration feedback by allowing them to hold the speakers to feel the rhythm through touch while viewing sound patterns on screen.

Teachers' feedback further revealed that this collaborative model strengthened pedagogical adaptability. Comments such as “*It is amazing, the students really look forward to it*” and “*students and adults enjoyed the sessions—would love to see these continue*” highlight sustained enthusiasm and confidence. The professional relationship between the tutor and teacher reflected situated learning and legitimate peripheral participation (Lave & Wenger, 1991), in which expertise developed through shared practice within the classroom community. Over time, the teacher moved from guided participation toward independent expertise, illustrating how collaborative co-design can foster authentic professional growth in context.

By mid-2025, the teacher demonstrated full ownership of the methods, contributing insights that informed lesson structures and resources for the broader MBI online course. Her trajectory—from supported implementation to confident, creative autonomy—shows how co-design can function as a powerful form of embedded professional learning within inclusive STEAM education.

5. Conclusion

This case study from *Beatrice Tate School* demonstrates how co-designed, music-led STEAM learning can strengthen both student engagement and teacher capacity within a complex SEND environment. By pairing specialist facilitation with classroom-based experimentation, the project created space for a classroom teacher new to music technology to progress from observation to confident, independent practice. The process reflects Lave and Wenger's (1991) concept of situated learning and legitimate peripheral participation, where professional growth develops through shared practice. Within this collaborative framework, the teacher built the skills to adapt digital music tools to meet the diverse sensory and cognitive needs of her pupils. For students with SLD and PMLD, the tactile and auditory immediacy of these tools transformed abstract cause-and-effect concepts into concrete sensory experiences. Consistently high engagement ratings and teacher feedback revealed notable gains in motivation, communication, and emotional well-being.

Equally significant was the teacher's growth in using technology creatively, refining lesson structures, and contributing to the design of the wider *MBI* learning pathways and online course. The findings suggest that co-design functions not only as an inclusive pedagogy but also as a form of embedded professional development, enabling teachers to integrate digital creativity into everyday teaching.

While focused on one school, this study highlights scalable principles—mentored collaboration, adaptive technology, and reflective practice—that can inform broader training models for inclusive STEAM education. Future work will track longitudinal outcomes, including sustained teacher practice and student progression, as the legacy phase of the *Music Beyond Imagination* project continues through 2025–2027.

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Generative AI in Learning: Five Advantages and Disadvantages for Cognition

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Abstract: *Generative AI tools such as ChatGPT are now embedded in students' everyday academic work. Research since 2022 shows that these systems can strengthen some cognitive processes while weakening others. This article synthesises peer-reviewed findings on the cognitive effects of generative AI in education and outlines five key advantages and five key disadvantages. Advantages include improved creative fluency, reduced extraneous cognitive load, more accessible personalised tutoring, enhanced metacognitive reflection, and greater equity of support for diverse learners. Disadvantages include cognitive offloading and skill atrophy, weaker long-term retention, diminished creative ownership, fragmented attention, and uncritical acceptance of misinformation. Overall, generative AI functions as a cognitive amplifier: it enhances comprehension and creativity when used interactively, but undermines deep learning when used as a shortcut. Responsible integration requires reflective use, clear guidance, and assessments that safeguard human reasoning.*

Keywords: generative AI, cognition, learning, creativity, metacognition

1. Introduction

Generative AI has become deeply integrated into everyday learning since the release of ChatGPT in late 2022. Students now use AI to draft essays, solve problems, plan assignments, generate ideas, and clarify concepts, prompting debate among educators, psychologists, and cognitive scientists about its impact on human learning. Some studies report benefits such as improved writing fluency, personalised clarification, and more efficient learning (Liu et al., 2025; Cheng et al., 2025). Others warn that excessive reliance may weaken critical thinking, memory, and the development of expertise (Sternberg, 2024; Öztürk and Mariani, 2024; D'Souza et al., 2025). These mixed outcomes reflect a tension around cognitive agency. While AI can help learners generate ideas, structure arguments, and receive feedback, it can also replace the cognitive effort needed for deep understanding and raise questions about how it affects cognitive load, motivation, attention, metacognition, and creativity.

This article provides a balanced summary of the most common findings on the cognitive benefits and risks of generative AI. It condenses current literature into five major advantages and five major disadvantages to offer a clear framework for understanding AI's dual impact. The aim is not to advocate for or against AI, but to support informed decisions about its educational use. The following sections present a concise review of studies from 2022 to 2025, followed by the ten key themes, and conclude with implications for future educational practice and human cognition.

This review is based on a systematically identified corpus of 37 papers. The author performed the literature search across multiple scholarly databases, focusing on studies published between 2022 and 2025. Inclusion criteria prioritized peer-reviewed sources, predominantly empirical studies (with a few analytical works), and research published in high-ranking journals (top-quartile journals in education, cognitive science, AI, and HCI).

2. Literature Review (Brief)

Research on generative AI in education has expanded rapidly since 2022. Studies reviewed in this article cover six central themes: creativity, learning performance, cognitive load, critical thinking, motivation, and metacognition. The following summaries present only the essential findings so the reader can understand the major patterns without unnecessary detail.

2.1. Creativity and Idea Generation

Studies consistently show that generative AI enhances creative fluency and output quality. Doshi and Hauser (2024) found that students who incorporated AI suggestions into story writing produced more creative narratives. Morales and van Dijk (2023) reported similar gains for short-form creative tasks. AI is especially helpful for learners who struggle with idea generation, offering examples and alternatives that reduce creative block (Mei et al., 2025). However, several studies caution that AI may narrow creative diversity across groups. When many students use the same model, storylines and structures tend to converge, reducing originality at the collective level (Doshi & Hauser, 2024; Zhou & Lee, 2024).

2.2. Learning Performance and Comprehension

Large-scale analyses show that generative AI can boost short-term performance on assessments. Students often report improved comprehension when AI offers simplified explanations or step-by-step solutions (Cheng et al., 2025). Meta-analyses by Liu et al. (2025) and Wang and Fan (2025) found that AI support improves achievement and perceived learning. Yet these benefits do not always translate into long-term understanding. Johnson et al. (2024) found that programming students who

relied on ChatGPT produced functioning code but struggled on later conceptual tests. Similarly, D'Souza et al. (2025) observed an illusion of learning among students who used AI heavily; their exam outcomes revealed weaker retention and transfer.

2.3. Cognitive Load and Offloading

Generative AI reduces extraneous cognitive load by summarising information, organising arguments, and handling procedural tasks. Farahani et al. (2023) found that students using AI completed tasks more quickly and with less mental effort. However, cognitive offloading can lead to superficial processing if learners do not engage with AI outputs. Zhang and Mullaney (2024) reported lower critical thinking scores among heavy AI users, who allowed the model to perform reasoning tasks for them. Neurocognitive research by Kosmyna et al. (2024) showed reduced activation in semantic processing regions when AI generated ideas for students.

2.4. Critical Thinking and Problem-Solving

Here the evidence is mixed. Over-reliance on AI can reduce critical reasoning because learners skip evaluation and accept AI outputs uncritically (Zhai et al., 2024). Dergaa et al. (2023) found that students sometimes incorporated incorrect AI explanations into science tasks. On the other hand, AI can strengthen critical thinking when used as a dialog partner. Dominguez and Kessler (2025) demonstrated that students who asked AI to critique their ideas generated deeper analyses. Barrera et al. (2024) found that debate students improved their reasoning when AI provided counterarguments.

2.5. Motivation and Engagement

AI assistance can reduce frustration, especially when students are stuck on writing or problem-solving tasks (Habib et al., 2024). Learners appreciate round-the-clock support and clearer explanations. However, multiple studies report reduced intrinsic motivation when AI does too much of the work. Mei et al. (2025) found that students who used AI in creative writing felt less ownership and pride in their work. Wu et al. (2025) observed that once students became accustomed to AI, performing similar tasks independently felt less rewarding.

2.6. Metacognition and Self-Regulation

AI can either enhance or weaken metacognition. Guided AI systems prompt learners to explain their reasoning, verify answers, and consider alternatives, which strengthens metacognitive awareness (Lee & Hammond, 2024). However, unguided use often leads to passive consumption and an inflated sense of competence. D'Souza et al. (2025) found that students became overconfident in their understanding when AI supplied slick explanations.

3. Five Advantages of Generative AI for Learning

3.1. Advantage 1: Enhanced Creative Output and Idea Generation

Generative AI improves the fluency, originality, and coherence of learners' creative work. Doshi and Hauser (2024) found that AI-supported writers produced stories rated as more creative and polished, and Morales and van Dijk (2023) reported similar results for short fictional narratives. These benefits are strongest for students with low creative confidence or limited language proficiency. Sun et al. (2025) observed that employees with weaker creative skills improved most when AI provided prompts and structural suggestions, and Mei et al. (2025) found that generative AI helped non-native English writers produce more fluent and expressive work. AI offers inspiration and stylistic variation that widens creative possibilities. Its positive effect stems from reducing creative block, generating diverse ideas, and offering examples that help learners visualise options. Students can request rephrasings, perspectives, or narrative directions, which stimulates ideation. Overall, AI raises the baseline quality of creative work and supports learners who may struggle to initiate or develop ideas. Notably, these creative gains are primarily observed in creative domains (e.g., writing tasks) where idea generation is critical.

3.2. Advantage 2: Reduced Extraneous Cognitive Load

Studies consistently show that generative AI reduces the cognitive burden of complex tasks by automating low-level processes. Farahani et al. (2023) found that students using ChatGPT reported significantly lower cognitive load during research tasks, as the AI summarised sources, organised information, and provided draft structures that reduced procedural strain. This allows learners to direct more cognitive resources toward understanding and analysis. In STEM learning, AI can provide step-by-step explanations that help students grasp difficult material more efficiently (Cheng et al., 2025). In programming, AI can assist with boilerplate code and syntax checks, enabling novices to focus on logic and problem solving. When used productively, generative AI reduces unnecessary mental effort and supports deeper engagement with content.

Importantly, this reduction in cognitive load is a general benefit evident across domains—from writing and research tasks to STEM problem-solving and programming.

3.3. Advantage 3: Personalised Tutoring and Adaptive Support

A key benefit of generative AI is its ability to act as a flexible, personalised tutor. ChatGPT adapts explanations to learners' questions, offers analogies, and responds instantly in a conversational format. Students often use AI to clarify difficult concepts when human support is unavailable (Cheng et al., 2025). Wang and Fan (2025) found that AI feedback enhances perceived learning, comprehension, and higher-order thinking. Barrera et al. (2024) observed that AI improved debate preparation by generating counterarguments, summarising evidence, and encouraging deeper reasoning. AI tutors are especially valuable in resource-limited settings or large classes where personalised support is scarce, helping to equalise learning opportunities by providing guidance at scale. This tutoring advantage applies broadly across subject areas, as AI can tailor support to any content domain where learners seek help.

3.4. Advantage 4: Support for Metacognition and Reflective Thinking

When used intentionally, generative AI can support metacognitive practices. Dominguez and Kessler (2025) found that students who explained their reasoning to AI developed clearer self-explanations and deeper conceptual understanding. The conversational format encourages learners to articulate their thinking, which strengthens metacognitive awareness. Lee and Hammond (2024) showed that prompting students to evaluate AI suggestions and justify their choices improves metacognitive accuracy. Guided AI systems that provide hints rather than direct answers help students monitor their understanding and maintain a reflective stance. In these contexts, AI acts as a reflective partner that encourages learners to slow down, question assumptions, and correct misconceptions. The metacognitive support provided by AI is domain-general, arising from how the AI is used to prompt reflection rather than from any specific subject matter.

3.5. Advantage 5: Increased Access and Equity in Learning

Generative AI can expand access to high-quality educational support. Students without tutors or strong academic backgrounds can use AI for explanations, translations, and examples (Barrera et al., 2024). AI can simplify text, clarify complex terminology, and adjust explanations to different proficiency levels. Mei et al. (2025) found that students with limited English proficiency benefited greatly from this support. AI also improves accessibility for students with disabilities by converting text to speech, summarising long readings, or offering alternative explanations for those with attention or processing challenges. Kasneci et al. (2023) note that generative AI can reduce inequality by providing personalised assistance. Because this benefit focuses on inclusive support rather than subject content, it spans all disciplines and learning contexts.

4. Five Disadvantages of Generative AI for Learning

4.1. Disadvantage 1: Cognitive Offloading and Skill Atrophy

One of the most widely documented risks is that students outsource thinking to generative AI rather than performing it themselves. This cognitive offloading reduces the effort needed for analysis, reasoning, and synthesis. Zhang and Mullaney (2024) found that heavy AI users scored significantly lower on independent critical thinking assessments and often admitted they let ChatGPT think for them. Öztürk and Mariani (2024) reported similar patterns, noting that students with constant AI access completed assignments quickly but performed poorly on conceptual tests requiring independent problem solving and frequently skipped key cognitive steps. Kosmyna et al. (2024) provided neurocognitive evidence that AI-assisted writing lowers activation in semantic processing regions, contributing over time to cognitive debt. This offloading risk occurs in any field—if AI does the thinking, students in all disciplines can experience skill atrophy.

4.2. Disadvantage 2: Reduced Memory Retention and Shallow Learning

Generative AI encourages shallow processing when students accept explanations without actively working through material. Deep learning relies on retrieval practice and generative processing, and when AI replaces these steps, retention declines. Farahani et al. (2023) found that students using ChatGPT for research tasks retained less information because they relied on summaries rather than integrating content themselves. D'Souza et al. (2025) showed that AI-assisted learners developed an illusion of competence, believing they understood material because AI provided fluent explanations, while exam results revealed weaker retention and conceptual grasp. Johnson et al. (2024) reported a similar pattern among novice programmers who used AI-assisted code and later could not recall problem-solving steps, indicating they had not internalised key concepts. Such shallow learning outcomes have been observed in multiple disciplines (from general studying to programming), indicating a broad, domain-general concern.

4.3. Disadvantage 3: Decline in Creative Ownership and Self-Efficacy

While generative AI can improve the quality of creative output, it may weaken learners’ sense of creative agency. Mei et al. (2025) found that students who relied heavily on AI produced better stories but felt less pride in their work, reporting that the writing no longer felt like their own, which reduced intrinsic motivation. McGuire et al. (2024) showed that users who only edited AI-generated content experienced declines in self-efficacy, whereas those who co-created with AI maintained confidence. When students treat AI as the primary creator rather than a collaborator, they may believe creativity comes from the system instead of themselves. Johnson et al. (2024) found that programming students who used AI frequently ended the course with lower confidence even when their assignments appeared successful, and this drop in self-belief can undermine resilience, persistence, and long-term creative development. This drop in ownership and confidence is seen in both creative fields (e.g., writing) and technical fields (e.g., coding), showing it is not limited to a single domain.

4.4. Disadvantage 4: Attention Fragmentation and Shallow Engagement

Generative AI can fragment attention by making learning tasks feel segmented or superficial. Öztürk and Mariani (2024) observed that students using AI often skipped steps, skimmed explanations, and showed fragmented engagement, moving between copying AI suggestions and inserting them into assignments without sustained focus. Eye-tracking research indicates that AI-assisted learners switch tasks more frequently and rely on surface-level scanning (Nguyen and Ra, 2023). Kosmyna et al. (2024) also found reduced activation in attentional control regions during AI-assisted writing, suggesting diminished cognitive engagement. When students depend on AI for quick solutions, they may become less tolerant of ambiguity or slow problem-solving, which weakens cognitive stamina. While documented mostly in writing tasks, this fragmented attention likely generalizes to any domain when quick AI solutions short-circuit sustained focus.

4.5. Disadvantage 5: Misinformation, Bias, and Reduced Critical Scrutiny

Generative AI can produce inaccurate information, known as hallucinations, and students who accept outputs without verification risk internalising incorrect facts or flawed reasoning. Zhai et al. (2024) found that over-reliance on AI dialogue systems weakened learners’ ability to evaluate information critically, and Dergaa et al. (2023) documented cases where students incorporated false AI-generated explanations into scientific work. Bias is another concern. AI models trained on large datasets reflect existing patterns that may include stereotypes or skewed perspectives, and without strong critical thinking skills students may absorb these biases, distorting understanding and undermining reflective judgment. AI can also reinforce confirmation bias by tailoring responses to a user’s implied beliefs, reducing exposure to alternative viewpoints (Zhang, 2025). These pitfalls of misinformation and bias can occur in any subject, but they are especially problematic in fields where factual accuracy or unbiased reasoning is critical.

Table 1. Summary of the five cognitive advantages and five disadvantages of generative AI in learning, with brief descriptions and notes on their domain generality.

Effect	Brief Description	Domain Scope
Enhanced Creative Output & Idea Generation	Eases creative blocks and improves idea fluency and quality; notably benefits struggling or novice writers	Domain-specific (mainly in writing & creative tasks)
Reduced Extraneous Cognitive Load	Automates low-level tasks (e.g., summarising sources, code scaffolding), reducing mental effort and freeing learners to focus on understanding	General (observed across domains, e.g., writing, STEM, programming)
Personalised Tutoring & Adaptive Support	Provides instant, personalised explanations and feedback to students, simulating a 24/7 tutor	General (useful across subjects for on-demand help)
Support for Metacognition & Reflection	Encourages learners to articulate their reasoning and evaluate AI suggestions, improving self-monitoring and metacognitive skills	General (effective in any domain when AI is used to prompt reflection)
Increased Access & Equity in Learning	Expands access via translations, simplified text, and other support, helping non-native speakers and students with disabilities	General (benefits diverse learners across disciplines)
Cognitive Offloading & Skill Atrophy	Over-reliance on AI reduces students’ practice of skills, causing their own critical thinking and problem-solving abilities to weaken	General (any subject where AI can replace thinking)
Reduced Memory Retention & Shallow Learning	Accepting AI answers without deep engagement impairs long-term retention; students may feel they understand, but memory and transfer suffer	General (seen in multiple domains, including coding tasks)

Effect	Brief Description	Domain Scope
Decline in Creative Ownership & Self-Efficacy	Using AI to generate content can make students feel less ownership, lowering their pride and confidence in their creative abilities	General (observed in creative writing and programming contexts)
Attention Fragmentation & Shallow Engagement	Frequent AI use encourages skipping steps and multitasking, splitting attention and leading to superficial engagement in learning tasks	General (documented in writing tasks; likely general across domains)
Misinformation, Bias, & Reduced Critical Scrutiny	AI may produce false or biased outputs; uncritical use can make students internalize inaccuracies and weaken their critical evaluation skills	General (risks present across domains, especially in fact-based subjects)

5. Discussion and Conclusion

Recent academic literature shows that generative AI produces two contrasting cognitive effects depending on how learners use it (as summarized in Table 1). When used thoughtfully, it acts as a scaffold that boosts creative expression, clarifies complex ideas, reduces cognitive load, supports reflection, and expands access to personalised help, aligning well with educational goals of comprehension, expression, and equity. But when students treat AI as a shortcut rather than a partner, it can erode the cognitive and motivational processes needed for deep learning. Over-reliance encourages cognitive offloading, weakens memory, reduces creative ownership, distracts attention, and dulls critical scrutiny.

The key challenge for educators is to guide students toward productive integration by promoting AI use for brainstorming, clarification, feedback, and critique while ensuring that reasoning, analysis, and synthesis remain human tasks. Assessment may also need to adapt by asking students to evaluate AI outputs, justify decisions, or demonstrate understanding independently.

In the long term, the role of human cognition in an AI-rich environment will depend on learners developing strong habits of critical thinking, self-regulation, and reflection. Generative AI will remain a central educational tool, and the priority is to ensure it functions as a partner in cognitive growth rather than a substitute for it. Used responsibly, AI can broaden learning possibilities, but passive use may erode the very capacities that education aims to strengthen.

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Enhancing Students' Socially Shared Regulation of Learning, Collaborative Problem Solving, and Learning Engagement in Science Education through an Embodied Mixed Reality Environment

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ABSTRACT

Traditional science education often struggles to support students in constructing a deep understanding of abstract scientific concepts and collaboratively regulating their learning processes, such as socially shared regulation of learning (SSRL). Existing literature largely relies on verbal or text-based hints to facilitate collaborative learning, offering limited embodied support for group regulatory processes. To address this gap, this study is grounded in embodied cognition theory and an AI-powered 3D-printed robot as a facilitator and tangible physical objects for science learning, together with Meta Quest 3 headsets, to create an embodied mixed reality (MR) environment that engages students' tactile, visual, and auditory senses. Our technical innovation centres on a vision-language model (VLM) that provides students with context-aware, action-triggered hints. Unlike traditional dialogue-based systems, our mechanism leverages Unity's physics engine to detect contact between students' hands and QR-marked physical objects, which automatically triggers intelligent pedagogical hints from the robot. These embodied interactions do not require explicit verbal or text-based queries but instead respond naturally to students' physical explorations during collaborative science learning. We conduct a usability study to examine the feasibility of this technological system, involving two science learning scenarios, namely exploring rocket-launch force principles and plant-growth processes, that support four stages of SSRL, including task preparation, planning, monitoring, and reflection. Results show that the system effectively supports SSRL, and embodied interactions enhance students' understanding of abstract scientific concepts. This research contributes a technically innovative framework that demonstrates how an embodied MR environment can advance more natural, bodily grounded forms of collaborative science learning.

KEYWORDS

mixed reality, embodied cognition, socially shared regulation of learning, collaborative problem solving, science education

以人才为导向的 STEM 教育：面向先进制造与新能源发展的香港中学课程优化

Talent-Oriented STEM Education: Enhancing Hong Kong Secondary Curriculum for Advanced Manufacturing and New Energy Development

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摘要

本研究旨在应对香港在先进制造与新能源科技领域日益增长的人才需求，探讨如何通过优化中学 STEM 课程，提升中学生对该领域职业的兴趣。研究基于社会认知职业理论（SCCT）与建构主义学习理论，采用混合研究方法，结合对香港企业专家、教师及学生的访谈与问卷调查，分析当前 STEM 教育与产业需求的差距。研究发现，香港中学生对相关领域职业认知度较低，而现有 STEM 课程内容分散、实践薄弱、与产业脱节。因此，本研究提出课程内容优化与教学方法创新双路径解决方案：在课程内容上，整合相关领域核心知识，设计模块化单元，如智能制造系统、工业机器人基础、3D 打印与数字技术，以及太阳能、风能、氢能应用技术等，并引入本土智能生产等企业案例；在教学方法上，推广项目式学习、场景化教学及职业模拟活动，增强学生学习体验与职业认同感。研究构建多维评价体系，从知识、能力与职业兴趣等维度评估优化效果。预期成果包括适用于香港的 STEM 教学资源包，并提出“产教”协同课程模型。

关键字

香港 STEM 教育；人才需求；先进制造；新能源科技；课程优化

探討生成式人工智慧融入 6E 教學策略應用於 STEM 教學與社會情緒學習之研究

A Study On Generative AI-Enhanced 6E Instructional Strategy for STEM

Education and Social-Emotional Learning

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摘要

近年來，生成式人工智慧（GAI）在教育領域的快速發展，推動學習模式轉向自主、互動與即時回饋。在此趨勢下，學生除了認知能力外，情緒調節、團隊合作等非認知能力日益重要。社會情緒學習（SEL）五大核心能力，已是學生在 GAI 時代提升學業成就與面對複雜挑戰的關鍵基礎素養。本研究主張，若能將 GAI 與 6E 教學策略有效結合並融入 STEM 課程，將有助於補足現有文獻中對 SEL 與 GAI 整合運用之研究缺口，並可提升學生於認知、情意與技能層面的整體表現。本研究採準實驗研究設計，以 120 名國中學生為研究對象，分為實驗組（60 人）與對照組（60 人）。研究介入為期六週，每週 50 分鐘，兩組皆接受主題為「製作賽車」之 STEM 課程。實驗組採用結合 GAI 的 6E 教學策略，對照組則僅採用 6E 教學策略。研究旨在比較兩組學生於認知表現（STEM 科學知識）、情意表現（自我覺察、自我管理、人際互動、團隊合作與負責任的決策）以及技能表現（實作能力）之差異。研究預期顯示，實驗組在認知、情意與技能三層面之表現將顯著優於對照組。本研究亦將提出 GAI 支援 6E 教學策略以促進 SEL 的跨域整合教學模式，期能為未來 SEL 融入 STEM 課程之設計與實務應用提供具體參考。

關鍵字

生成式人工智慧；社會情緒學習；6E 教學策略；STEM 課程；實作表現

AI 教學型代理人結合自主學習與檢索增強生成技術對高中生在 STEM 實作課程

學習成效態度與實作表現之影響

**The Impact of AI Agents Integrating Self-Regulated Learning (SRL) and
Retrieval-Augmented Generation (RAG) on High School Students' Learning
Outcomes and Engagement in STEM Practical Courses**

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摘要

當前教育趨勢強調高階問題解決與自主學習 (SRL)，但在 STEM 實作中，通用型生成式 AI 常因知識錯誤或缺乏課程依據而不可靠，成為 SRL 鷹架設計的關鍵缺口。本研究旨在透過檢索增強生成 (RAG) 技術彌補此缺陷，探討其對高中生在 AIoT-STEM 專題中學習成效、認知負荷與自我調節表現。研究採準實驗設計，課程為期 10 週、每週 100 分鐘，招募約 80 名高一學生並施以前測以控制先備經驗變項。實驗組採用 RAG 型 AI 助理，強化 SRL 循環中「執行監控」與「自我反思」的可靠依據；對照組則使用無 RAG 支援之 GAI。本研究將關鍵概念嚴謹操作化：認知層面採用 Leppink et al. (2013) 測量認知負荷；情意層面包含採用 Hsiao et al. (2023) 測量程式自我效能、改編 Cavas et al. (2020) 問卷評估 SRL 表現；技能層面運用創意產品評分矩陣 (CPAM) 評定實作表現。預期實驗組在自我效能、實作表現上將顯著優於對照組，並能有效降低外在認知負荷，為未來 AI 智慧鷹架設計提供具理論深度與方法論規範之實證依據。

關鍵字

自主學習策略；檢索增強生成技術；STEM；AI 教學助理

代理型 AI 結合自主學習與 RAG 於 STEM 實作課程，探究 SRL 啟用時機對高中
生學習成效與延宕保留的影響

Exploring the Effects of SRL Activation Timing on High School Students'
Learning Performance and Delayed Retention in a STEM Hands-on Course
Integrating AI Agents, Self-Regulated Learning, and RAG

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摘要

面對 AI 與物聯網技術快速融入 STEM 教育現場，學生在跨域專題探究中常因資訊量龐大與任務複雜度高而增加學習負荷，導致目標設定、策略運用與自我監控能力不足。本研究旨在透過一個準實驗設計，比較自主學習策略 (Self-Regulated Learning, SRL) 鷹架啟用時機對高中生在長期學習表現的影響。教學實驗為期 14 週，分為兩階段教學：前段啟用組在階段 I 啟用完整的 SRL 與 AI 代理人 (Agent) 結合 RAG 功能的主動鷹架，階段 II 則降為低干預；後段啟用組則在階段 I 處於低干預，階段 II 才啟用主動鷹架。此設計旨在系統性分析 AI 代理人所提供的 SRL 支援，在不同時機點導入與移除 (鷹架保留/漸退) 後，對學生的知識保持與自我調節策略遷移 (策略延宕) 的影響。依變項涵蓋認知 (基礎程式能力、認知負荷)、情意 (程式設計自我效能、自我調節學習) 與技能 (實作表現) 三構面。預期成果將提出在 AI 代理人研究在長期、策略性效應分析上的實徵研究，並為未來 AI 輔助 STEM 教育的教材開發與教學設計提供關鍵依據。

關鍵字

AI 代理人；自主學習策略；AIoT-STEM 課程；延宕保留

教學型 AI 代理人融入高中 STEM 專題導向學習對認知負荷與問題分析能力之影響

Effects of an AI Pedagogical Agent on Cognitive Load and Problem Analysis in High School STEM Project-Based Learning

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摘要

高中 STEM 實作任務繁複，學生易因認知負荷上升而降低問題分析能力與學習投入，現行 AI 工具回饋多不貼近操作情境，難以有效支援學習。本研究將教學型 AI 代理人 (AI Pedagogical Agent) 導入智慧城市八週 STEM 專題課程，探討其對學生學習歷程與表現的影響。研究採準實驗設計，對象為某高中兩班約 60 名學生，一班為實驗組，另一班為對照組。兩組皆依專題導向學習 (Project-based learning, PBL) 步驟進行，引導學生從問題探索、方案構想到成果展示。實驗組在課堂中使用結合檢索增強生成 (Retrieval-augmented generation, RAG) 的教學型 AI 代理人，其引導式鷹架依專題導向學習 (Project-based learning, PBL) 各階段設計，於學生學習歷程中提供情境化的即時教學支援，提供概念澄清、任務拆解、基本除錯與操作提示，對照組則採傳統 PBL 教學，由教師協助。課程結合物聯網概念、Arduino 感測與控制以及程式設計，並以智慧垃圾桶的專題製作作為課程成果。研究蒐集認知負荷、問題分析能力、學習投入的前後測成績與作品實作表現，比較兩組學生在學習表現上的差異。預期 AI 的即時支援可降低學生在實作過程的困難感，提升任務掌握、方案品質與學習動機，並為 AI 融入 STEM 實作課程提供具實務價值的參考。

關鍵字

教學型 AI 代理人；專題導向學習；STEM；檢索增強生成；認知負荷

生成式 AI 與自動化評分工具在香港文憑試中文寫作評估中的效度驗證：與官方評
分標準的一致性及其差異研究

Validation of Generative AI and Automated Scoring Tools in the Assessment of
Chinese Writing in the Hong Kong Diploma of Secondary Education Examination:
A Study of Consistency and Differences with Official Scoring Standards

刘上

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摘要

近年来，生成式人工智能及自动化评分工具在教育评估中的应用日益广泛，但在高风险标准化考试中的效度尚待验证。本研究以香港中学文凭考试中文写作卷为对象，探讨 GenAI 与自动化评分结果同官方评分标准的一致性与差异。研究问题：自动评分与官方评分是否具有统计一致性？其评语能否准确覆盖立意、内容、语言、结构等核心维度？如何构建更高效可靠的人机协同评分模型？研究采用语料库构建与 GenAI 解析相结合的方法。首先系统收集 2015-2025 年香港考评局发布的各等级考生作文示例及评分描述，构建结构化语料库。其次运用大语言模型（GPT-5）及自动化评分工具，依据官方标准对样本进行分项评分与评语生成。接着通过科恩卡帕系数、加权 Kappa 与 Spearman 相关系数检验评分一致性，并结合文本编码分析评语差异。最后基于实证结果，构建人工与自动评分的综合模型，以提升评分效率与信度。预期成果将为 GenAI 及自动化评分工具在中文写作测评中的应用提供效度证据，并为评分体系优化提供理论与方法支持。

關鍵字

生成式 AI；自動化評分；效度；評分標準；香港中學文憑試

Strand

Virtual and Blended Teaching and Learning

虛擬與混合教學與學習

Designing a Primary School Digital Well-Being Website and Education Workshop: Supporting Senior Primary School Students and Parents Co-Learn to Prevent Social Media Addictions

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ABSTRACT

Social media use is imperative, pervasive, and widespread among senior primary students. They are always used for communication, entertainment, and gaming, especially during the pandemic. Nevertheless, rising social media addiction poses serious risks to students' emotional, mental, and psychological health, contributing to anxiety (often from peer pressure and comparison), depression, frustration, and lowered self-esteem. Besides, it can also affect physical health, including increasing the risk of shortsightedness. Children frequently engage in social comparison online, shaping self-image and self-presentation. Parents are significant others, primary socializers, and caring family members. Authoritative parenting is a more effective parenting style. Parents need to have solid and specific knowledge, discipline, and practical strategies to address this. This research proposes a self-learning package (i.e., educational website) with family-centered intervention to help parents and children understand social media addiction, build healthy online habits, adopt supportive parenting styles, and reframe negative perceptions of children's digital habits. This initial study employed a design-based study, collected different literature research, and provided around a total of ten parents' and students' initial thoughts. We are advocates for balanced, healthy, and wholesome social media use and stronger family-guided digital well-being. Parents are essential life tutors to co-learn and promote positive values of using social media and maintain their better digital well-being. Handling social media addiction through parents and senior primary school students is pivotal for senior students to reinforce emotional, mental, and social well-being while making better family relationships and communication and benefiting from the transfer to another stage of secondary education.

KEYWORDS

Digital well-being, Parenting Styles, Social Health, Social Media Addiction

It's All about Students: Mapping the Discourse Structure of a Teacher-focused Online Discussion Forum

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Abstract: *Social media research uncovers hidden patterns, and open, anonymous forums are invaluable for accessing real-life disclosures that might otherwise be unreachable. To explore the often unspoken perspectives of teachers and related parties, the current study analysed the top 250 posts from an online forum called r/Teachers. To identify the core features of the online discourses, this investigation was guided by three research questions, each focusing on node-, edge-, and community-level aspects of the resulting text network, which was created through a pipeline combining Natural Language Processing and network analysis steps. The node-level findings, which emphasise the central, outreaching, and bridging roles of key terms such as “student”, are expected, given the main subject of the curated text corpus. More intriguing results, however, are at the edge- and community-levels: there are no significant links between “student” and other terms; the main bridge connecting communities, where the “teacher” and “student” nodes are located, relates to student discipline; macro-level processes are mainly associated with “teacher” and inversely with “student”; and there are numerous connections between mental responses and student-related clusters. These emerging patterns highlight the potential value of follow-up network analyses in uncovering commonly silenced perspectives on the everyday experiences, roles, and key concerns of teachers.*

Keywords: text network analysis, discourse structure, online forum, teachers’ perspectives

1. Introduction and research problem

Social media research is both a rich and highly challenging field. It utilises large volumes of complex data generated by users on social media platforms to identify hidden patterns and insights that are not immediately obvious (Hjorth & Hinton, 2019). Among social media platforms, Reddit, Inc. (2025) aims to be “home to thousands of communities, endless conversation, and authentic human connection,” serving as a promising platform for providing real-life, self-initiated transactional self-disclosure data that are otherwise inaccessible, thanks to its anonymous nature (Carpenter and Bret Staudt Willet, 2021). However, despite previous efforts to examine Reddit in education (for example: Kerr et al., 2025, on the departure of teaching staff), the number of studies using Reddit as a data source in this field remains limited, as demonstrated by only nine journal papers out of 338 publications identified in Proferes (2021), with just 24 additional post-2020 journal articles identifiable through ProQuest as at October 2025.

Given the unique importance of studying online communities of teachers and other interested participants, and considering the inadequacy of existing research, this study aims to characterise the discourse structure of a selected online forum using text network analysis. The investigation is guided by three research questions: (1) What are the most central ideas in the forum, and how effectively do they serve as idea hubs? (2) What are the most prominent co-occurrence patterns among ideas, and which links connect different topical areas? (3) How are the ideas clustered, and in what ways are these clusters interconnected? The following four terms and their associations are particularly significant due to their high relevance to everyday experiences in schools: “student”, “teacher”, “parent”, and “school”.

2. Methodology

Social network analysis, where graphs about the inter-agent relations are created, allows the patterns that are otherwise not easily observed to be revealed (Scott, 2017). Text networks, which were understood as “social networks of language” by Stuart and Botella (2009), allow the relationships between concepts to be analysed (Yun & Park, 2018).

In the current text network analysis project, the text corpus was compiled from the top 250 Reddit posts in the r/teacher subreddit, URL: <https://www.reddit.com/r/Teachers/>, which serves as a platform where the “shared affinity and affordances of anonymity” encourage users, presumably mostly teachers, to “seek information, advice, or emotional support” (Na & Staudt Willet, 2024). This subreddit was chosen because of its focus on teachers, as indicated in its community rule 2.1: “Produce content that focuses on topics most teachers can relate to.” However, it is recognised that the subreddit is not exclusively for teachers, as reflected in its rule 4.1: “Students, parents, and non-teachers are welcome to post respectful questions for better understanding” (r/Teachers, n.d.). Therefore, we should interpret the selected subreddit as reflecting the views of mainly teachers, along with other interested parties in education. The curated text was processed through the steps described in Table 1.

Table 1. Key analytical steps

	Key processes	Remarks
Step 1	Curating the dataset	250 Top Reddit posts on Oct 7, 2025, in JSON, converted to CSV
Step 2	Text normalisation	Posts converted to lowercase and cleaned by normalising steps
Step 3	Tokenisation and lemmatisation	Text broken into words and converted to the canonical forms
Step 4	Term condensation	Condensing synonyms, e.g., “schooler” included under “student”
Step 5	Stop word removal	Stop words removed while keeping domain token, e.g., students
Step 6	Co-occurrence extraction	Co-occurrence pairs within sliding windows detected
Step 7	Graph building	Graph where edges are weighed by co-occurrence frequency
Step 8	Computation of measures	Measures reported in Section 3 computed

The analysis was conducted using Python 3.11 with the support of SpaCy 3.8.5 for Natural Language Processing, igraph 0.11.9 for calculating various network measures, and leidenalg 0.10.3 for community detection. The resulting networks were imported into Gephi 0.10.0 for visualisation. Throughout the analytical process, the author makes decisions that affect the generated graphs and subsequent measurements. These decisions range from node-level inclusion criteria (e.g., minimum token occurrence) to community detection parameters (e.g., Leiden (weighted) resolution). The optimisation of these parameters was guided by exploratory data analysis to enhance the clarity and interpretability of the data reports. The key parameters selected by the authors during the analysis are listed in Table 2. Additionally, the graph created for analysis (i.e., Step 7 in Table 1) is included in Figure 1 below.

Table 2. Key parameters set for analysis

Parameter	Values	Considerations
Minimum token occurrence	2 tokens / corpus	Remove noise brought by very rare tokens
Sliding window size	10 tokens	Small window size for syntactical level focus
Minimum edge weight	2 co-occurrences	Remove noise resulting from weak co-occurrences
Edge distance	1 / ln (1 + weight)	Avoid large weights from dominating the shortest paths
Minimal degree of nodes	2	Remove peripheral nodes that destabilise communities
Leiden (weighted) resolution	1.0	Balance granularity and interpretability

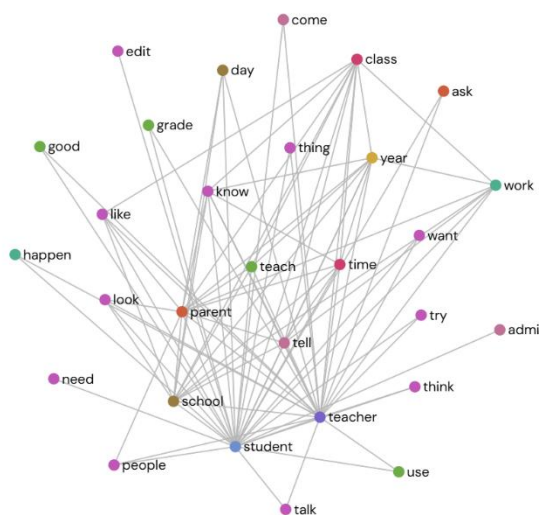


Figure 1. Network produced and analysed. Nodes coloured to represent the communities that they belong to. Network nodes and edges of lower degrees and weights were heavily filtered to improve clarity and accessibility.

3. Results and discussion

3.1. Node-level characteristics

There are 1,906 nodes in the resulting graph, and an inspection of Table 3 reveals the most frequent nodes within the assembled corpus. All four focal terms, namely, “student”, “teacher”, “school”, and “parents”, are among the most commonly found nodes. The first two terms have the highest weighted betweenness centralities (> 150,000) among all nodes (including those not shown in the table), acting as important bridges between different topic areas in the forum.

Table 3. Top 8 nodes in descending occurrences

Node	Occurrences	Degree	Strength (thousands)	Betweenness (thousands)
1. student	1161	1882	62.4	164.3
2. teacher	346	1276	21.6	178.3
3. school	320	1167	20.0	91.4

4. parent	296	1032	17.1	87.1
5. class	234	979	15.0	50.8
6. year	230	960	14.0	48.4
7. tell	212	923	14.2	52.2
8. know	178	881	12.0	31.3

Note: Degree is unweighted; Strength and betweenness are weighted and min-max normalised on a 0 – 1 scale

To differentiate the more central nodes from the more peripheral ones, the k-core indices of various words were calculated, and the top 8 are shown in Table 4. All listed nodes are situated in the innermost core ($k = k_{max} = 75$), indicating they are all core terms within the resulting text network. Despite their position in the innermost core and their high in-core degrees and strengths, most of these nodes have a small share of neighbours within the core (<20%). This suggests they act as semantic hubs in the subreddit corpus, firmly embedded in the core while being extensively connected to more peripheral terms, i.e., nodes with lower k-core indices, effectively bridging the core and the periphery. The “student” node has the greatest in-core strength but the smallest proportion of neighbours among all nodes in the innermost core, indicating that “student” is the most central hub with the broadest outreach.

Table 4. Top 8 nodes in descending k-core indices

Node	k-core index	Degree in core	Strength in core (thousands)	Fraction of neighbours in core
1. student	75	162	28.98	8.61%
2. school	75	160	10.17	13.71%
3. teacher	75	162	9.94	12.70%
4. parent	75	160	8.62	15.50%
5. class	75	158	7.69	16.13%
6. tell	75	159	7.29	17.23%
7. year	75	157	7.15	16.35%
8. know	75	155	5.99	17.53%

Note: When the degree / strength / fraction of neighbours in the core is measured, the nodes (and the edges connecting to these nodes) include those with a k-core index with the same or higher k, as in the standard convention.

3.2. Edge-level characteristics

The resulting graph is a sparse network with 22,689 edges and a density of 0.012. Table 5 displays the top 8 edges with the highest co-occurrence counts (i.e., weights), which represent the strongest term associations. The Pointwise Mutual Information measure highlights co-occurrences that are greater than expected by chance alone. As shown in the table, the normalised PMI (NPMI) values are around 0.1, indicating near-chance associations between these most frequently co-occurring terms.

Table 5. Top 8 edges in descending weights

Term 1	Term 2	Weights	PMI	Normalised PMI
1. parent	student	293	1.45	0.157
2. school	student	268	1.14	0.122
3. student	teacher	248	0.94	0.099
4. class	student	209	1.23	0.127
5. student	tell	167	1.01	0.101
6. student	year	166	0.94	0.093
7. student	teacher	140	1.17	0.113
8. student	time	133	0.94	0.090

Note: PMI = Pointwise Mutual Information; Normalised PMI scales PMI into the range of -1 to 1; Focal terms are bolded.

Another set of crucial edge-level characteristics involves the structurally important bridges between terms, specifically the potential connections between different communities (or groups) of terms. The information is presented in Table 6, where edge betweenness focuses on the graph-level global “broker” terms, and Jaccard coefficients focus on local connectivity. The edges displayed serve as key links that connect ideas across communities (term clusters) with the shortest semantic distance (high edge betweenness and conductance contribution). Still, there are at least some shared neighbours of the corresponding nodes (with moderate Jaccard coefficients). A particularly noteworthy edge is the punishment-student edge (item 5 in Table 6), which has a minimal Jaccard coefficient (0.007) but a high edge betweenness (2452.6). This suggests that the “punishment of students” acts as a more exclusive bridge between otherwise separate communities (Communities 1 and 2 in Table 7 of the next section) than most other edges in the table. Additionally, as seen in both Tables 5 and 6, “student” appears in all entries, highlighting its key position in the curated discussions.

Table 6. Top 8 edges in terms of edge betweenness

	Term 1	Term 2	Edge betweenness (thousands)	Jaccard coefficients	Conductance contribution
1.	student	teacher	5.39	0.428	0.952
2.	student	time	2.65	0.263	0.953
3.	parent	student	2.61	0.371	0.954
4.	school	student	2.52	0.384	0.954
5.	punishment	student	2.45	0.007	0.978
6.	student	year	2.43	0.306	0.953
7.	class	student	2.37	0.320	0.953
8.	know	student	2.37	0.277	0.952

Note: Conductance contribution normalised into the range of 0 to 1; All edges above involved nodes that are assigned to different Leiden communities (resolution = 1.0); Focal terms are in bold font.

3.3. Community-level characteristics

The Newman modularity (Q) of the resulting graph is 0.151, indicating a modest community structure where the topical clusters are interconnected but still recognisable. Ten clusters of ideas have been identified using the Leiden algorithm, and Table 7 describes the top six communities by size. The leading clusters reveal some underlying themes of the forum. The clustering pattern may reflect the perspective in which teachers are more associated with collective processes and macro- to meso-level structures. At the same time, students are linked to individual processes and meso- to micro-level structures. Parents, in such cases, engage with the school authorities about student matters.

Table 7. Top 6 communities in the network in descending number of nodes

ID	Labels	Nodes	Posts	Top terms (by strength)
1.	Teacher and curriculum	354	243	teacher , teach, grade, education, state, job, read, level, new, learn, classroom, test, actually, teaching, can't
2.	Students in classrooms	353	246	student , class, time, today, look, talk, start, room, sit, find, period, group, hand, minute, friend
3.	Opinions and reactions	331	246	know, like, edit, think, don't, want, it's, thing, need, people, good, feel, post, way, hear
4.	Schooling and time	276	237	school , year, high, old, district, end, happen, leave, middle, gun, ago, long, month, kind, graduate
5.	Parent-school relations	203	226	parent , email, principal, right, issue, behaviour, life, meeting, speak, sure, update, absolutely, entire, address, she's
6.	Administration and discipline	199	234	tell, I'm, admin, come, home, wear, bad, dress, shirt, code, hour, head, place, follow, able

Note: Labels are manually added in view of the top terms of the respective communities; Focal terms are in bold font.

The key relationships between the communities are captured in Table 8. While the student-teacher pair remains among the top cross-community edges (i.e., entry 2), the pair with the highest weight is between "students" and "opinions", suggesting that the cognitive and affective processes of the students (e.g., "know" and "like", respectively) are closely linked and much discussed in the forum posts.

Table 8. Top 8 cross-community edges in descending order of total weights

	Community pairs	Count (thousands)	Weight (thousands)	Top connecting edges (weights)
1.	2 – 3	4.62	43.1	know- student (478); like- student (394)
2.	1 – 2	3.58	33.9	student-teacher (953); student-teach (560)
3.	1 – 3	4.43	33.7	know- teacher (179); good- teacher (119)
4.	2 – 4	2.89	26.9	school- student (1116); student-year (678)
5.	3 – 4	3.21	23.7	know- school (154); school-want (134)
6.	2 – 5	2.42	21.7	parent- student (1070); right- student (177)
7.	2 – 6	2.23	21.3	student-tell (704); come- student (377)
8.	1 – 4	2.65	21.2	school-teacher (450); teacher-year (333)

Note: Counts and weights refer to the number of connections between the said communities, calculated in unweighted and weighted manners, respectively; Focal terms are in bold font.

4. Concluding Remarks

The current study characterises a teacher-focused online forum, and findings at node, edge, and community levels have been identified. While the focus on students at the node level is unsurprising for a forum dedicated to teachers and other interested parties, the lack of strong associations between "student" and other common terms is interesting. It is also

noteworthy that the “teacher” and “student” clusters of terms are connected by the “punishment-edge”, which might imply the prevalence of discipline-related posts in the forum. The association of macro-level and collective processes with “teacher” and the reverse with “student” might reflect in-school role assignments, and the strong associations between the cognitive and affective processes and “student” is also a finding that should be further explored in subsequent studies.

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Advocating Virtual-based Learning: Designing P3 students with Games to Promote Learning Autonomy in Hong Kong Primary English

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Abstract: *In recent years, educators have been growing research interest in educators adopting innovative pedagogies for primary education after the post-COVID-19 era. Primary English Language serves as a compelling context for educators to design learning products that advance students' language proficiency alongside their autonomy, competence, and motivation. One supported approach is the integration of targeted educational games into lesson planning and classroom practice to strengthen learners' intrinsic motivation. This research developed 3D educational games using the Unity platform to create immersive virtual classrooms and user-generated content aligned with the Hong Kong Primary English curriculum, specifically the Primary 3 "Food and Fast Food" module. The educational intervention applied a user functional test for conducting the evaluation. We invited primary school students from a Hong Kong community center (n = 24) to play the games and provide firsthand experiential feedback. To complement this, we invited participants (n = 46), including pre-service teachers and social workers with diverse backgrounds and professional expertise related to primary education, in order to obtain more rigorous and comprehensive evaluations. This research finding indicates a positive association between the use of educational games in 3D environments and students' motivation to learn in English classes. Learners demonstrated higher motivation when engaging with the game-based materials. The design of games exemplifies the elements of connecting, synthesizing, and transforming knowledge in education and reflects a creative and innovative pedagogical orientation. Ultimately, this research aims to share pedagogical innovation with the professional community of education scholars, practitioners, and the broader public.*

Keywords: Virtual-based learning, Education Games, Primary English Language, Learning Motivation, Perceived Learning

1. Introduction

Hong Kong primary school students frequently encounter persistent challenges in acquiring vocabulary and transferring it to written production in English. Key reasons for students' engagement are lower achievement and limited engagement during whole-class instruction, repetition of high-frequency lexical items in traditional curriculum, and inadequate opportunities for consolidation and retention (Bai et al., 2020; Bai & Guo, 2021; Lam, 2019; Lee, 2011a, 2011b; Park & Wang, 2019; Sze, 2008). To address learning gaps, this research designed and implemented an instructional intervention that integrates a Unity 3D educational game with collaborative Padlet writing tasks. The approach investigates how digital storytelling and scenario-based missions can contextualize target vocabulary and sentence structures within meaningful communicative tasks. Simultaneously, Padlet scaffolds collaborative ideation, peer evaluation, and appreciation. Learners can consolidate learning outcomes, and educators can handle classmates' learning performance.

2. Research Question

1. What design features of 3D educational games most effectively support primary students' development of English writing?
2. How can game-based learning elements be aligned with instructional objectives to meet both educator and learner needs?
3. What are Primary 3 students' perceptions, engagement levels, and learning experiences when interacting with a 3D educational game?
4. What do the primary school students feel towards 3D educational games?

3. Literature Review

3.1. Educational Games, Gamification, and Game-Based Learning

Games constitute structured play oriented toward explicit goals and bounded by rules and constraints (Cheng et al., 2015). Gamification refers to the application of game elements, like levels, points, badges, leaderboards, avatars, and quests, to non-game contexts to impact learning motivation and shape learner behavior (Deterding et al., 2011; Krath et al., 2021; Seaborn & Fels, 2015; Zainuddin et al., 2020; Zichermann & Cunningham, 2011). In educational settings, thoughtfully designed game mechanics can foster engagement, enhance motivational states, and scaffold problem solving (Kapp et al., 2014). A growing evidence base associates game-based learning (GBL) with positive affective outcomes (e.g., motivation, enjoyment, flow), behavioral outcomes (e.g., participation, collaboration), and cognitive outcomes (e.g., knowledge acquisition, critical and

creative thinking) (Bai et al., 2020; Boyle et al., 2016; Connolly et al., 2012; Koivisto & Hamari, 2019; Qian & Clark, 2016; Sailer & Homner, 2020; van Gaalen et al., 2021; Vlachopoulos & Makri, 2017).

3.2. Metaverse Learning

Metaverse learning environments are characterized by immersion, interactivity, social presence, and persistence, affording authentic contexts for language learning and heightened engagement (Castañeda et al., 2024; Damaševičius & Sidekerskienė, 2024; Li & Yu, 2023; Thango, 2024). Simultaneously the literature highlights potential downsides, including distraction and novelty effects that may overshadow learning goals. To mitigate these risks, researchers recommend explicit instructional design, clear guidance, and graduated scaffolding to ensure cognitive gains and sustained performance improvements (Li & Yu, 2023; Thango, 2024). Practical applications reported include collaborative vocabulary development and increased participation among quieter students and learners with diverse needs through avatar-mediated interaction (Çelik & Baturay, 2024; Misha, 2023).

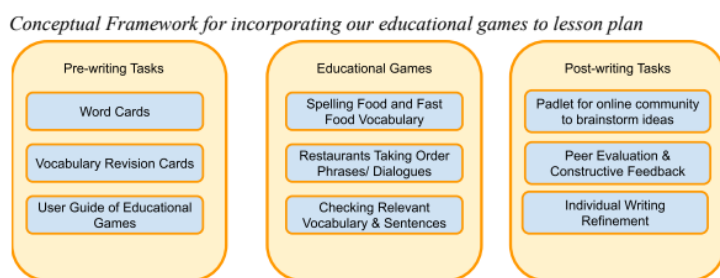
3.3. Blended and Personalized Learning

Blended learning integrates face-to-face and online modalities to transform pedagogical and learning patterns (Bonk et al., 2002; Dalsgaard & Godsk, 2007; Garrison & Vaughan, 2008). Personalization and self-directed learning extend this framework to provide tailor-made learning pathways to achieve individual needs and offer flexibility and formative feedback (Illi & Elhassouny, 2025; Li & Yu, 2023; Thango, 2024). The above approaches can optimize pacing, differentiate support, and reinforce transfer through iterative practice and reflection.

4. Digital Technology Application

This researcher leveraged the Unity platform to develop three-dimensional (3D) learning environments. Unity enables the construction of interactive 3D game mechanics, including missions, levels, and staged challenges, supported by robust code, scripting, and asset pipelines. Generally, designers can rapidly design prototypes and deploy immersive environments for educational and recreational purposes, integrating 2D/3D assets and video to create visually engaging, interactive experiences. Another, complementary platform like Spatial.io also provides virtual collaboration by hosting immersive 3D spaces where users can meet, communicate, and co-create. By using augmented and virtual reality technology, digital platforms create user-friendly spaces that can improve engagement, communication, and productivity for teaching and designing metaverse classrooms. In addition to the 3D educational game, we integrated Padlet as a visual collaboration platform to structure the writing process. Within Padlet’s web-based boards, students were invited to generate and curate images to support idea development, access and check out teacher-uploaded learning materials (i.e., 5W1H questionings, useful sentence patterns, and vocabulary) and post drafting group writing, receive formative comments, and conduct peer appreciation and evaluation. Overall, the Unity–Padlet integration afforded a holistic workflow for English writing: the 3D game contextualized vocabulary and sentence structures through narrative tasks and simulated scenarios, while Padlet organized collaborative ideation, drafting, feedback exchange, and revision cycles. Unity and Padlet in combination moved learning beyond isolated word acquisition or stand-alone gameplay toward socially mediated, reflective writing practices aligned with blended and self-directed learning paradigms.

5. Conceptual Framework



Grounded in game-based learning and gamification, the design integrates nine elements shown to boost engagement and learning (Krath et al., 2021; Lam, 2022): (i.) clearly articulated lesson aims, objectives, and relevance to learners’ context; (ii.) Personalized goal setting tailored to learner profiles and proficiency; and (iii.) immediate feedback embedded within gameplay. Also, involving positive reinforcement and encouragement through rewards and progress indicators; (iv.) Peer appreciation and evaluation; (v.) Adaptive, which personalizes pacing and difficulty; (vi.) Guided learning trajectories with scaffolding or instructions; (vii.) Streamlined, low-friction user experience to minimize extraneous cognitive load; (viii.) Task-based learning sequence: Informed by Lam’s (2022) conceptual framework, the intervention uses an individual–group–individual sequence to structure task-based learning. Pre-task activities include vocabulary review cards and an in-game user guide; the core task is enacted within the 3D environment; post-task consolidation transitions to scaffolded writing; (viv.) Self-regulated and collaborative learning: The design purposefully blends self-regulated learning (goal setting, monitoring,

reflection) with collaborative knowledge construction, leveraging both in-game cooperation and Padlet-mediated peer interaction.

5.1. Unity-enabled 3D learning design

The Unity-based environment delivers narrative quests and scenario-based missions that contextualize target vocabulary and sentence patterns (i.e., identifying foods, fill-in-the-blanks, spelling tasks, and sentence completion). Difficulty is calibrated through progressive levels, adaptive hints, and varied task types, enabling both individual practice and small-group collaboration. Real-time feedback, visual progress cues, and badge-like milestones reinforce mastery and sustain motivation. The 3D context affords authentic, low-stakes rehearsal of language use, supporting transfer to written production.

5.2. Padlet-supported process writing

Padlet is a visual collaboration platform for education and creative work that structures the writing cycle beyond gameplay. Following gameplay (e.g., vocabulary such as “hamburger” and “French fries”), students compose 60–80-word scenario-based texts (e.g., planning a visit to a restaurant or fast-food shop), drawing explicitly on in-game lexicon and structures. Students can eventually rate appreciation points of other students' group writing.

5.3. Blended, personalized, and microlearning alignment

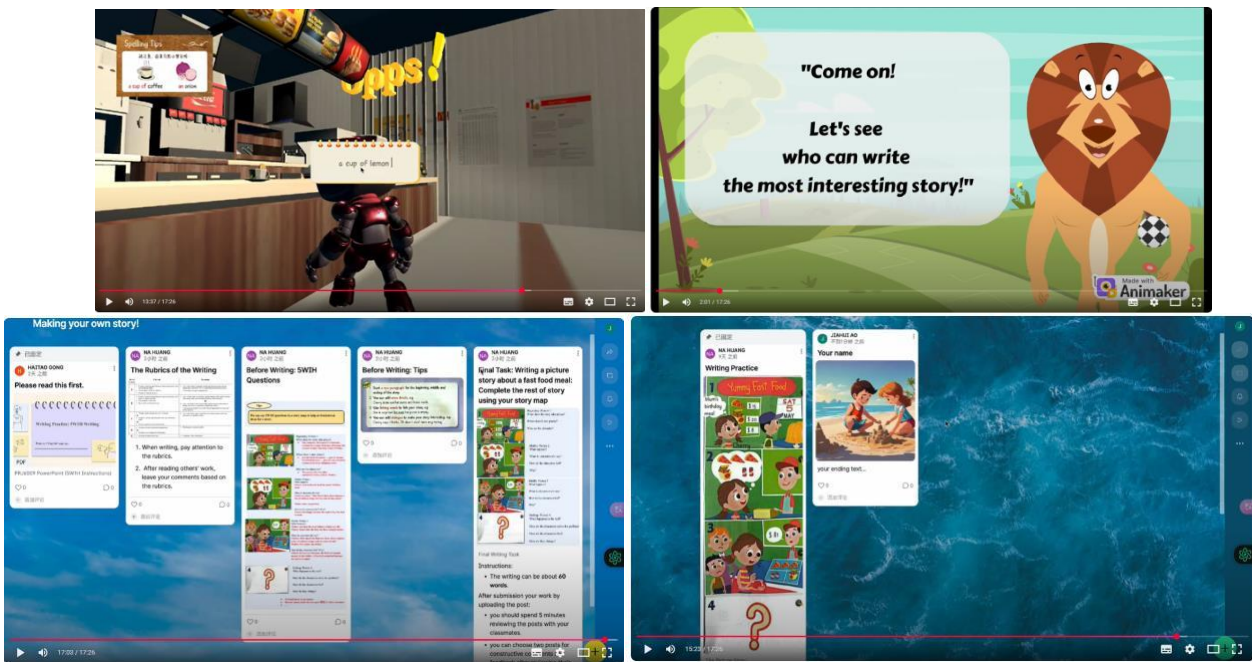
The pedagogy reflects blended learning as a fundamental redesign of instructional structures and interactions (Garrison & Vaughan, 2008), combining in-class facilitation with online, asynchronous composition and feedback via Padlet. Personalized learning is supported through adaptive game mechanics in Unity and differentiated scaffolds on Padlet, accommodating learner variability and promoting autonomy. Microlearning principles are even embedded through short, focused spelling game tasks and bite-sized writing activities that encourage spaced practice, reflection, and transfer. Within this blended ecosystem, educators flexibly orchestrate modalities to align with learning objectives and student needs, thereby creating a more responsive and effective learning environment (Lam, 2022; 2024). These components aim to improve vocabulary retention, sentence construction, and the transfer of oral/interactive language experience into coherent written output for Hong Kong Primary 3 learners.

6. Proposed Lesson Design

The instructional game is implemented on the Unity platform and organized around a narrative arc set on “Kuku Planet.” Learners follow Sam, the protagonist, on a quest to locate Lily, guided by Kuku King and supported by Chef Tom. Progression through the world requires completing linguistically targeted tasks that unlock restaurants and provide clues, thereby sustaining purpose and immersion. After entering the Kuku planet, in order to enter restaurants or get more reminders to find her, students are required to complete different tasks. For instance, it may need to identify some ingredient names for dishes (e.g., congee, apple pies, noodles, mushrooms, ham, rice, jam, butter, cheese, and onion). This vocabulary is the targeted vocabulary that needs to be learned by students. After finding Lily, Lily indeed is a boss and director of restaurants; she would like to invite all students to support restaurants due to insufficient staff in the restaurants. Lily provided tasks to students, like using polite request forms and container/quantity phrases (a slice of pizza, a box of chicken wings, a can of cola, a bottle of water, and a packet of French fries). Dialogues model transactional language (e.g., “May I have...?”, “Here you are,” “How much is it?”). One of the unique features of our report is the instructional videos; three short videos introduce the setting, quest, and tasks to ensure clarity, reduce cognitive load, and keep language in focus. Secondly, we have designed it to have collaborative writing; we are recommending students from 4 to 6 members as a group to draft the scenario writings. Only one requirement is to use flexible words from what you learn in the educational game or food and fast-food textbooks and contents.

Padlet Workflow and 5W1H Scaffolding: Padlet Board 1: Image generation/curation to spark story ideas; students can use 5W1H (who, where, when, what, why, how) and make prompts to have selected images. Padlet Board 2: Posting of drafts with the whole class Padlet and mind checklists (container phrases, polite requests, and vocabulary range). Students are able to give stars or other words as feedback on students' writing regarding content, language (vocabulary use), and organization.

Although recently Hong Kong and Taiwan conducted similar research, different research on understanding solid perspectives of primary students' learning English motivation and 3D educational games is very unique and exceptional.



7. Intervention Plan and Evaluation

Timeline and deliverables: The project ran from January to April 2025 (approximately three months). Core activities included iterative development of the Unity-based prototype, production of scenario videos, construction of Padlet boards, and authoring of an educator lesson pack. Final deliverables comprised (i.) video presentation and display, (ii.) Padlet, and (iii.) lesson plan with lesson materials.

Recommended P3 students Lesson structure:

- Pre-lesson (15–20 minutes): State learning objectives; model 5W1H; conduct rapid activation tasks.
- In-game (20–30 minutes): Engage in Unity-based activities (e.g., spelling target words, food identification, sentence-pattern recognition, scenario listening); small-group discussion on spelling and noun-phrase formation.
- Debriefing (5–10 minutes): Surface challenging vocabulary; model target structures; conduct brief checks for understanding with responsive questioning.
- Writing (20–30 minutes): Padlet-enabled collaborative drafting, peer evaluation, and whole-class reflection.
- Homework: Individual scenario-based writing aligned with textbook resources.

Research Procedures: Our test was divided into two parts. Firstly, I invited 24 primary school students to English Day Camp Activities that were co-organized by the learning buddies service team at EDUHK and one of the non-governmental organizations in Tai Po. We prepared around 105 minutes for this session, as we can schedule 15 minutes for doing the questionnaires. Simultaneously, in order to make the results more accurate and demonstrate different stakeholders' or users' perspectives, I have also conducted functional tests. Students are required to complete learner mini self-reflection report. I also invited and used purposive sampling, inviting 46 participants, who were either pre-service teachers at EDUHK or other participants like social workers, to give more observations and insights on how to make the educational games to demonstrate the highest efficiency and effectiveness. They not only provide the recommendations and suggestions for educational games but also review some of the lesson materials so that they can give a balanced and comprehensive perspective of how to incorporate learning goals and educational game functions. Some participants were also invited to join our focus group interview to see how educational game design fits for primary 3 English learning, which selected participants expertized in English and technology disciplines. Apart from qualitative and quantitative research methods, I also used the observational field notes and self-reflection to support my research process.

Measurements: The evaluation combined student user testing, stakeholder functional testing, and ethical safeguards. Student testing employed five-point Likert scales (1–5) to rate overall gameplay experience, interest/engagement, and perceived learning effects, complemented by structured observation protocols and brief debrief prompts. Stakeholder testing used ten-point ratings (1–10) to assess sensitivity to learner needs, feasibility, creativity/innovation, educational transformation, language learning value, presentation quality, functional robustness, technology use, appropriateness for Primary 3 learners, and evaluation efficiency. Participation was voluntary, with consent/assent procedures coordinated by the community center and social worker for minors, and all data were anonymized for analysis and reporting.

8. Research Results

1. User Test: User testing examined three dimensions via five-point Likert items—overall gameplay experience (Q1), perceived interest (Q2), and perceived learning effects (Q3). Overall experience was positive across grades, with P1 averaging 5/5, P2 at 3.75/5, and P5+ at 3.80/5; high ratings were most common among P2 (n=9, 38%) and P5+ (n=10, 25.1%), suggesting the interface and mechanics were accessible for both early and upper primary learners despite differences in prior vocabulary and gaming familiarity. Interest remained robust, with P1 at 5/5, P2 at 4/5, and P5+ at 4.60/5, and high marks concentrated among P2 (n=9, 37.2%) and P5+ (n=11, 26.7%), indicating sustained engagement driven by narrative and interactivity. Perceived learning effects were also favorable—P1 at 5/5, P2 at 4.4/5, and P5+ at 3.38/5—with high ratings led by P2 (n=13, 32.5%) and P5+ (n=11, 26.5%); P2 reported the strongest gains, aligning with the module’s lexical targets. Overall, learners across primary grades found the game engaging and beneficial, with especially strong responses among P1 and P2 for experience/interest and among P2 for learning effects, reflecting alignment with curricular vocabulary and task difficulty.

2. Functional Test: A stakeholder functional test with pre-service teachers and social workers (n = 46) evaluated feasibility, usability, pedagogical value, and Primary 3 fit, yielding an overall prototype rating of 7.17/10 (median = 7.5; mode = 8; SD = 1.79), indicating a “good” solution with solid feasibility, clear presentation, reliable functionality, appropriate technology use, suitability for Primary 3, and efficient evaluation potential. Qualitative feedback highlighted strengths in gamified learning—immersive 3D environments, interactive tasks, and a coherent narrative that boosted motivation—along with engaging interactivity/visuals (e.g., robot guides) and an innovative, reflective design with vivid art and well-developed characters that supported understanding. Simple observation: (i.) P3 students think that educational games have higher feasibility, creativity/innovation, appropriateness, language learning value, and technology use, and (ii.) educational games are enjoyable, motivating, and satisfying and have higher willingness.

9. Technical and Our Research Gap

To provide more extension from project research to scholarly research study, ongoing research validation and verification of research methods are needed. In the future, I will utilize this pilot study and consolidate different pre-tested tools (like surveys) with proven reliability and reference for different data methods, data sources, theories, or investigators to cross-verify findings. Therefore, it can use the cross-check items to reinforce the validity and depth by confirming results from different angles, often combining qualitative and quantitative approaches for richer, less biased insights. Additionally, it can enhance the established reliability (consistency) and validity (measuring what they intend to) through rigorous testing. For example, I will utilize more in-depth interviews and observations to develop a solid research study. Apart from a basic understanding of high enjoyment and engagement, it is essential to extend research on whether students were genuinely focused on learning or merely motivated by the game mechanics (like time length and details of research). There is also no behavioral data or task quality analysis to verify cognitive engagement. Also, whether the design will include updated AI functions. For instance, Liang et al. (2024) research demonstrated that the AI-assisted chatbot approach with 3D educational games could significantly ameliorate learners' metacognition awareness, emotional engagement and behavioral engagement.

10. Limitation, Conclusion and Future Prospect

This research demonstrates the feasibility and pedagogical value of designing English language learning experiences through 3D platforms like Unity and Spatial.io to facilitate game-based learning and foster innovation, autonomy, motivation, and interest among primary learners and to enhance vocabulary acquisition, sentence construction, and writing development. When coupled with a visual collaboration platform like Padlet, educators can structure process writing, document learning artifacts, and facilitate peer feedback within a coherent, data-informed workflow. The intervention illustrates how a well-orchestrated ecology—Unity for immersive, goal-driven practice and Padlet for collaborative drafting and reflection, like assisting explicit goal alignment, scaffolded practice, immediate feedback, and positive reinforcement. These elements directly target vocabulary retention, sentence patterning, and writing motivation, while audiovisual design and narrative context enhance interactivity, relevance, and transfer to written production. Recognition mechanisms (e.g., badges or certificates) can further reinforce progress, provided they complement rather than supplant intrinsic motivation. Research findings also underscore the importance of learner-centered refinement. To optimize accessibility and cognitive load, future iterations should prioritize readability (font size and contrast), concise dialogue and pacing, aesthetic consistency, and graduated, constructive hints. These user-experience and pedagogical adjustments are actionable and likely to improve usability and learning outcomes, particularly for child learners. More broadly, the results suggest that cross-sector collaboration—among teachers, social workers, and university staff can accelerate the adoption of digital technologies that support both academic growth and holistic development. As a pilot study, incremental contribution is noted. By integrating immersive environments with structured collaborative tools, schools can expand the repertoire of evidence-based, blended practices that are responsive to learner diversity and aligned with achieving teaching and learning curriculum. To consolidate future research, this research suitably emphasizes on the learning motivation with self-determination theory, future work also need to address cognitive load and add objective learning outcome measures (e.g., pre–post vocabulary tests, rubric-scored writing samples, and transfer tasks).

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AI–Metaverse Co-Constructed Cultural Memory Field: A Knowledge-Building Study in Virtual Immersive Heritage Education

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Abstract: Recent advances in artificial intelligence (AI) and Metaverse technologies have enabled immersive and interactive forms of cultural heritage education. However, existing studies are largely technology-driven and lack theoretically grounded models that explain how such environments support learning and cultural understanding. This study proposes the AI–Metaverse Cultural Memory Model (AIMCM), a five-layer framework—Perception, Interaction, Meaning Construction, Ecological Synergy, and Value Reconstruction—to conceptualize how AI-mediated immersive environments facilitate knowledge building in heritage education. A quasi-experimental study was conducted with 312 participants, comparing an AIMCM-based Metaverse learning condition with a traditional multimedia-based control condition. Multimodal data, including questionnaires, behavioral logs, and physiological indicators, were analyzed using linear mixed models and mediation analysis. Results indicate that learners in the AIMCM demonstrated significantly higher learning engagement and cultural understanding than those in the control condition. The findings suggest that AIMCM provides a theoretically interpretable framework for understanding how AI and Metaverse technologies jointly support immersive heritage learning.

Keywords: Metaverse, Artificial Intelligence, Cultural Memory, Immersive Learning, Knowledge Construction

1. Introduction

The integration of artificial intelligence (AI) and Metaverse technologies has transformed the ways cultural heritage can be represented, experienced, and learned. Through immersive three-dimensional environments, AI-generated narratives, and embodied interaction, learners are increasingly able to engage with cultural content beyond traditional text- or image-based formats (Jung & tom Dieck, 2017; Buragohain et al., 2025). While prior research has demonstrated the potential of virtual reality and AI systems to enhance engagement in heritage education, much of the literature remains focused on technological affordances rather than learning mechanisms (范炜, 2025).

From a cultural-educational perspective, heritage learning is increasingly understood as a process of activating cultural memory within pedagogical contexts rather than merely transmitting historical facts (李文霞, 2025; Assmann, 2012).

A key limitation of existing studies lies in the absence of theoretically articulated frameworks that explain how immersive and intelligent environments contribute to knowledge building and cultural understanding. Many Metaverse-based heritage projects emphasize realism or interactivity but do not sufficiently connect design features to educational and cognitive theories. As a result, claims regarding learning benefits often lack explanatory depth.

To address this gap, this study proposes the AI–Metaverse Cultural Memory Model (AIMCM), a layered framework that conceptualizes learning in immersive heritage environments as a progressive process from sensory perception to value reconstruction. The study further examines whether learning outcomes under the AIMCM conditions differ from those of a traditional multimedia-based learning condition.

The research is guided by the following questions:

RQ1: How can the core components of the AIMCM framework be theoretically defined and interpreted?

RQ2: Do learners in an AIMCM-based Metaverse environment demonstrate higher learning engagement and cultural understanding than those in a traditional learning condition?

RQ3: What learning mechanisms help explain the observed outcomes?

2. Theoretical Background

2.1. Cultural Memory and Identity Formation

Cultural memory refers to socially constructed representations of the past that shape collective identity and value systems. Unlike individual memory, cultural memory is mediated through symbols, narratives, and shared practices, enabling societies to transmit meaning across generations (Assmann, 2011). In heritage education, learning is not limited to factual knowledge acquisition but involves learners' engagement with cultural meanings and identity-related values.

Digital technologies extend cultural memory beyond physical sites by enabling reconstruction, reinterpretation, and interactive participation. When learners actively engage with cultural narratives, they are more likely to internalize cultural meanings and develop a sense of identification. Thus, effective heritage education requires environments that support both cognitive understanding and value-oriented engagement.

2.2. Embodied and Constructivist Learning

From a learning-science perspective, immersive environments support embodied cognition, where perception, action, and cognition are tightly coupled (任达 & 王舒一, 2023). The sense of presence afforded by immersive media allows learners to experience knowledge through situated action rather than passive reception. Constructivist theories further suggest that learners actively construct meaning through interaction with tasks, tools, and social agents.

Digital and virtual environments transform cultural representation from systems of technical encoding into symbolic meaning-making spaces, where cultural narratives are reconstructed through interaction rather than static display (司培, 2025).

AI-enhanced learning environments introduce additional mediation by adapting content, responding to learner behavior, and supporting dialogic interaction. When combined with immersive technologies, AI can function as a cognitive mediator that means scaffolds meaning construction rather than merely delivering information (Creswell & Plano Clark, 2018).

3. The AI–Metaverse Cultural Memory Model (AIMCM)

3.1. Overview of the Framework

The AI–Metaverse Cultural Memory Model (AIMCM) conceptualizes immersive heritage learning as a progressive, multi-layered process. Unlike technology-centered frameworks, AIMCM focuses on learning mechanisms and cultural meaning construction (Buragohain et al., 2025). The five layers are not isolated components but represent an integrated developmental pathway through which learners engage with cultural memory.

3.2. Operationalization of the AIMCM Framework

Generative AI techniques, while originally developed for data synthesis and representation learning, provide a technical foundation for adaptive narrative generation and content mediation in immersive environments (Goodfellow et al., 2020).

To operate the AIMCM framework in empirical settings, the present study implements the model through a three-stage analytical pipeline.

The framework operates in three stages. First, a conventional solution reference set is dynamically generated using a large language model and stabilized through semantic normalization to serve as a cognitive baseline. Second, student solutions and the reference set are encoded into a shared semantic space using sentence-level embeddings, enabling computation of semantic distance. Third, novelty is quantified as divergence from conventionality and supplemented with formative feedback highlighting sources of originality. Full technical specifications are provided in supplementary materials.

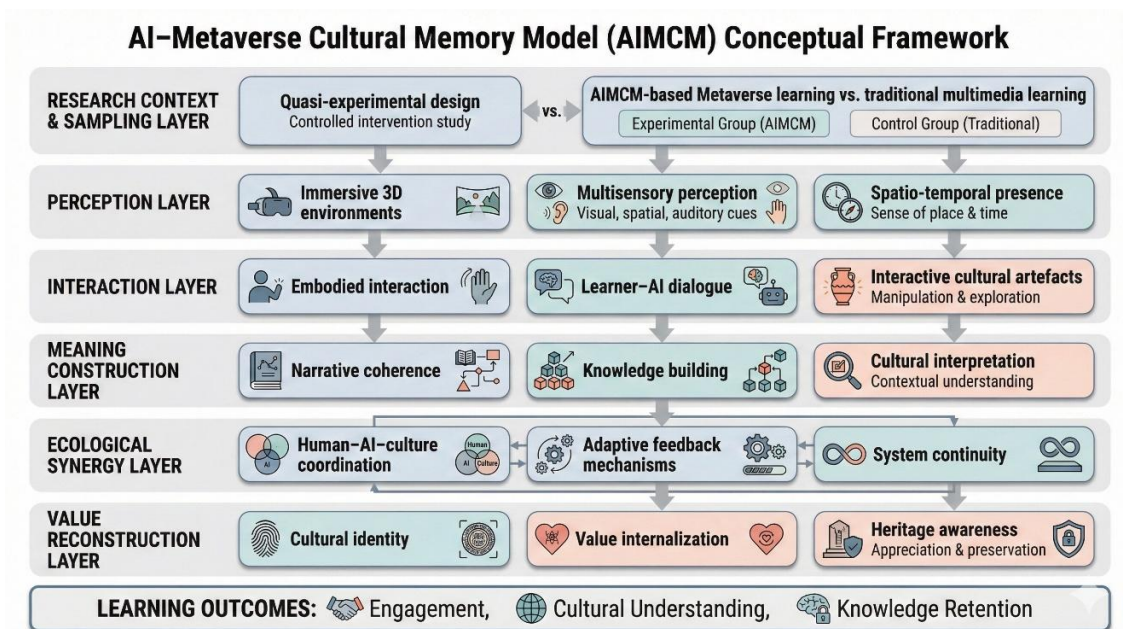


Figure 1. The framework of AI-Metaverse Cultural Memory Model

3.3. Mechanism-Based Expectations of the AIMCM Framework

Grounded in embodied cognition and constructivist learning theories, the AIMCM framework conceptualizes immersive heritage learning as a mechanism-driven process rather than a technology-centered intervention. Each layer of the model is expected to contribute to learning outcomes through distinct but interrelated functions.

Specifically, the Perception and Interaction layers are expected to primarily influence learners' behavioral engagement and attentional allocation, particularly in the early phases of immersive learning. These processes provide the experiential conditions necessary for the Meaning Construction layer, in which learners integrate perceptual and interactive experiences into coherent cultural understanding.

The Ecological Synergy layer further supports this process by enabling adaptive coordination between human learners, AI systems, and cultural representations, thereby sustaining continuity and coherence in the learning experience. Finally, the Value Reconstruction layer reflects learners' internalization of cultural meanings and identity-related values, representing outcomes beyond immediate knowledge acquisition.

Accordingly, this study expects that increased behavioral engagement and interaction under the AIMCM condition will be associated with higher levels of cultural understanding, with meaning construction serving as a mediating mechanism rather than assuming direct causal effects from technological immersion alone (任达 & 王舒一, 2023; Creswell & Plano Clark, 2018).

4. Methodology

4.1. Participants and Design

A total of 312 participants with diverse cultural backgrounds took part in the study. A quasi-experimental design was adopted, with participants assigned to either an AIMCM-based Metaverse learning condition or a traditional multimedia-based control condition. Both groups covered the same cultural heritage content.

4.2 Learning Environments

The AIMCM consisted of three Unity-based Metaverse learning environments, including immersive historical scenes, interactive artifact exploration, and an AI-supported virtual guide. The control condition used conventional multimedia materials, such as videos and textual explanations, without immersive interaction.

Types of Projects	Topics	Educational Outcomes
Virtual Museum Scene	Intelligent Historical Environment	Provides an immersive historical experience
Virtual Museum Scene	Artefact Showcase	Increases interactive participation and learning interest
AI Virtual Teacher	DeepSeek based AI Teacher	Provides a personalized virtual teaching experience

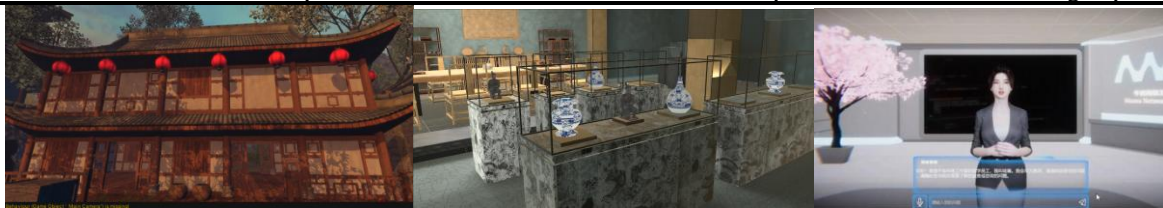


Figure 2. The proposed three types of project made by Unity platform

4.3. Measures and Data Analysis

Learning outcomes were assessed using validated Likert-scale questionnaires measuring learning engagement and cultural understanding. Behavioral indicators (e.g., interaction frequency, navigation patterns) and physiological data (eye-tracking and EEG-derived indicators) were collected to triangulate learning mechanisms. Data were analyzed using linear mixed models, with learning condition as the fixed effect and participant as a random effect. Mediation analysis was conducted to examine the role of interaction and immersion.

5. Results

5.1. Descriptive Results and Condition Comparison

Table 1 presents descriptive results across the three AIMCM-based implementations and the control condition. Overall, learners in the AIMCM demonstrated higher levels of learning engagement, cultural understanding, time-on-task, and interaction frequency than those in the traditional multimedia condition.

Implementation Type	Outcome Measure	AIMCM Condition (Mean ± SD)	Control Condition (Mean ± SD)	Data Source
Virtual Museum Scene Reconstruction	Historical knowledge score (5-point scale)	4.21 ± 0.46	3.62 ± 0.51	Post-learning assessment
	Narrative comprehension score (5-point scale)	4.08 ± 0.49	3.55 ± 0.53	Scenario-based test
	Average time-on-task (minutes)	8.1 ± 1.7	5.4 ± 1.9	System log

Implementation Type	Outcome Measure	AIMCM Condition (Mean \pm SD)	Control Condition (Mean \pm SD)	Data Source
Virtual Museum Artefact Showcase	Interaction frequency (per session)	12.6 \pm 3.1	6.8 \pm 2.7	Behavioral log
	Cultural knowledge retention (5-point scale)	4.15 \pm 0.44	3.58 \pm 0.50	Delayed post-test
	Artefact recognition accuracy (%)	81.3 \pm 9.2	67.5 \pm 10.4	Recognition task
	Perceived cultural relevance (5-point scale)	4.27 \pm 0.42	3.61 \pm 0.48	Self-report scale
	Knowledge retention score (5-point scale)	4.09 \pm 0.47	3.54 \pm 0.52	Post-test
AI Virtual Teacher	Expressive task performance (5-point rubric)	4.02 \pm 0.51	3.48 \pm 0.56	Performance rubric
	Learner–AI interaction count (per session)	14.8 \pm 4.2	5.9 \pm 2.1	Interaction log
	Learning satisfaction (5-point scale)	4.31 \pm 0.40	3.66 \pm 0.46	Survey

Table 1. Descriptive Results of AIMCM-Based Metaverse Learning Implementations

From a learning-science perspective, the observed differences between the AIMCM and control conditions can be interpreted through the interaction of embodied engagement and constructivist meaning-making processes. The increased time-on-task and interaction frequency observed under the AIMCM conditions suggest that perceptual immersion and interactive affordances facilitated sustained learner engagement, consistent with theories of embodied cognition.

Importantly, the learning benefits observed in the AIMCM condition were not limited to subjective satisfaction but extended to knowledge retention and task performance across multiple implementations. This convergence reduces the likelihood that the findings can be explained solely by a novelty effect associated with immersive technologies (Buragohain et al., 2025).

Rather than functioning as a direct causal agent, AI in the AIMCM framework operates as a cognitive mediator that scaffolds learners' interaction with cultural content (Creswell & Plano Clark, 2018; 任达 & 王舒一, 2023). Through adaptive feedback and narrative guidance, AI-supported interaction appears to support continuity in the meaning construction process, thereby linking engagement-related mechanisms to deeper cultural understanding.

5.2. Multimodal Evidence of Learning Engagement

Beyond self-report measures, behavioral and physiological data revealed consistent engagement patterns in the AIMCM condition. Learners maintained attention for longer durations and interacted more frequently with learning elements across all three implementations. These multimodal indicators provide converging evidence supporting the descriptive outcomes reported in Table 1.

6. Discussion

The results support AIMCM as a mechanism-oriented framework for explaining learning in AI-mediated immersive heritage environments. The Perception and Interaction layers facilitated embodied engagement, contributing to sustained attention and active participation. These processes supported Meaning Construction, enabling learners to integrate experiential information into coherent cultural understanding. Text-to-image and generative prompt techniques were informed by recent advances in prompt engineering for large-scale generative models, enabling controllable and context-sensitive visual representation (Mookdarsanit & Mookdarsanit, 2023).

The Ecological Synergy layer highlights the role of AI as an adaptive learning mediator rather than a passive content provider. By responding to learner behavior, AI-supported environments contributed to continuity and coherence in the learning process. Finally, the Value Reconstruction layer explains learners reported cultural relevance and awareness, reflecting the internalization of cultural meaning beyond factual knowledge acquisition.

Despite these findings, the study has limitations. The intervention duration was relatively short, and AI-generated narratives may reflect cultural biases. Future research should employ longitudinal designs and cross-cultural comparisons to further validate the AIMCM framework.

7. Conclusion

This study proposes the AI–Metaverse Cultural Memory Model (AIMCM) as a theoretically grounded framework for understanding how AI-mediated immersive environments support knowledge building in cultural heritage education. Through

a comparative, multimodal study, the findings indicate that AIMCM-based learning environments are associated with higher levels of learner engagement and cultural understanding than traditional multimedia approaches.

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Synchronous Text-Based Online Counseling for Junior High School Students: Addressing Academic Self-Efficacy Concerns through Reality Therapy-based Psychoeducation

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ABSTRACT

As interest in the use of online modalities for delivering mental health services increased after the COVID-19 pandemic, this study aimed to investigate the impact of psychoeducation delivered through synchronous text-based online counseling (STBOC). Academic self-efficacy – a student’s self-belief in their capacity to perform well in academic tasks – was found to by previous studies to be negatively affected during the forced implementation of online schooling. Undertaking a study on this remains relevant due to its correlations to academic concepts and student quality of life. The study addressed the said concerns through Reality Therapy-based psychoeducation, primarily due to its established positive impact on academic self-efficacy. Limiting the target population to junior high school students, focus group discussions were used to determine the students’ perception of STBOC after going through the Reality Therapy-based psychoeducation. A mixed-method, pretest-posttest design was also used to compare the results of the Academic Self-Efficacy Scale for Filipino Junior High School Students and interviews before and after the intervention. The FGDs revealed the students’ positive regards on STBOC. All participants expressed willingness to undergo STBOC. The data also revealed that the plurality preferred STBOC compared to other modalities. The data highlighted the following themes: disinhibition, temporal fluidity and recordability, fluid and transcended space, content, and media disruption and security. The data also presented significant positive effects on the students’ academic self-efficacy after going through the intervention. Wider use of this modality may provide better accessibility for counseling services and its addition to the counselor curriculum may be considered.

KEYWORDS

synchronous text-based online counseling, academic self-efficacy, junior high school students, Reality Therapy, psychoeducation

Work-based Learning in Simulated Work Settings: Case Study of Two VPET Programmes in Hong Kong

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ABSTRACT

The higher education sector in Hong Kong is undergoing a profound transformation with a new official policy initiative to develop vocational and professional education and training (VPET) as a pathway parallel to conventional academic education. To pursue the integration of industry and education, work-based learning is essential for the delivery of VPET by offering structured learning opportunities in authentic or simulated work settings for learners to acquire vocational and professional knowledge and skills. This paper analyzes the quality assurance mechanism, curriculum design, and operational practice of two VPET programmes in tourism & hospitality and social work respectively. A case study approach is adopted to examine the success factors of how programme providers ensure (1) simulated work settings for work-based learning are best aligned with the authentic context in the industry and profession, (2) practical skills and knowledge in the field are effectively embedded into pedagogical design and training, and (3) learners are well-equipped with on-the-job skills and readily transferable to the workplace. The study provides a great deal of intensive observations from and reflections upon the relevant challenges, strategies and practices. Collectively, this paper attempts to advance instrumental materials and insights for the optimization of work-based learning in simulated work settings.

KEYWORDS

work-based learning, vocational training, professional education, simulated work setting, quality assurance

AI Dialogic Reading and Mental State Talk: Enhancing Theory of Mind in Early Childhood

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ABSTRACT

This study investigated whether an AI reading companion could strengthen children's theory of mind (ToM) skills through dialogic reading that emphasized emotional and mental state talk. Using an AI-powered storybook app, Star Reading, the companion was designed to engage children in emotional and mental state rich dialogue during shared reading. Thirty-three Chinese children aged 6–7 years in Hong Kong participated in a one-month intervention, reading digital storybooks with the AI companion approximately four times per week. Pre- and post-tests assessed ToM and expressive vocabulary, with total learning duration recorded as covariates. Results from ANOVA revealed that the intervention group demonstrated significantly greater improvement in ToM scores compared to the control group, while no significant differences were observed in expressive vocabulary. These findings suggest that embedding mental state language into AI-mediated dialogic reading can effectively foster young children's ToM development, highlighting the potential of AI integration in early literacy contexts. By supporting children's ability to understand and reason about others' thoughts and emotions, AI reading companions may offer innovative pathways for advancing socio-cognitive growth alongside traditional educational practices. Future research should validate these results with larger samples, explore long-term developmental outcomes, and examine broader applications of AI-enhanced dialogic reading in diverse cultural and educational settings.

KEYWORDS

dialogic reading, theory of mind, AI, mental state talk, emotion

Student Perspectives across Disciplines in the Hybrid Learning Model

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ABSTRACT

With the increase in the use of hybrid learning models in higher education, understanding students' experiences and perspectives is crucial for developing effective programmes. This research proposal explores student views on hybrid learning in higher education, focusing on disciplines within early childhood and sports. The study aims to compare the students' preferences between hybrid and traditional formats, examine the perceived effectiveness and difficulties, as well as factors influencing these preferences. The research employs a mixed-methods approach. Quantitative data will be collected through a department-wide questionnaire targeting approximately 100 students, ensuring representation across the two specific disciplines, while qualitative insights will be drawn from semi-structured interviews with a purposive sample of 15 participants. Interview questions will address the perceived advantages of hybrid modules, the anticipated effects of hybrid modules on future coursework, and potential barriers that might impede their implementation. In addition, the study examines the evolving role of artificial intelligence (AI) as a supporting tool in hybrid learning in areas, particularly in adaptive feedback, content personalisation, and student engagement. Quantitative data will be analysed using descriptive statistics, and qualitative data through thematic analysis. Expected results include a comprehensive understanding of student expectations, perceived benefits of flexibility and increased involvement, as well as concerns about workload, technology, and instructional quality. The findings will offer empirical recommendations to help faculty and administrators in the development of an effective hybrid learning model, in accordance with student needs.

KEYWORDS

hybrid learning model, student experiences, teaching and learning innovation, student engagement, instructional design

AI-Driven Creative Expression for Senior Adults: A Case Study of a Community-Based Art Project

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ABSTRACT

In an aging digital society, AI-facilitated, communal creative expression provides seniors with an accessible tool for imaginative output within a supportive social context. By making the AI's behavior visible, a community-based art project called the Digital Playhouse invited 38 senior adults (aged 60-75) to experience a series of prompt-based AI image generation workshops, including image-to-image and image-to-animation transformation. The workshops were conducted in three steps: 1) transparency: plain-language demos showed what task was and how the AI generated "that" image; 2) learner control: participants rewrote prompts and styles, iterating until the image felt "mine"; 3) social connection: participants shared phrases and celebrated creations on the online playhouse platform, turning pixels into collective pride. During the workshops, participants treated every click of the "generate" button as a conversation rather than a command. Data collection from observations and informal interviews revealed a general improvement in mood and self-confidence: seniors smiled or leaned forward when an image matched their concept idea, many re-edited prompts several times, and most logged into the online platform to view their peers' work, while some downloaded their peers' work. Barriers noted across conversations included confusion over technical terms, difficulty reading small interface text, and occasional frustration with fine-tuning the prompt controls. Taken together, the Playhouse findings confirm that AI-facilitated, community-based artmaking offers senior adults an easy-entry pathway to vivid self-expression while surrounding them with peers who applaud each iteration, sustaining both creative momentum and social connection.

KEYWORDS

Senior Adults Education, AI-facilitated, Community-based Art, Social Connection

A Speech-Based Chatbot Framework for Multi-Level Reading Comprehension

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Abstract: *Recent progress in speech large language models (LLMs) has expanded the potential of chatbots in education. However, most existing reading comprehension chatbots remain screen-based and lack systematic pedagogical design, which may reduce learners' comprehension and engagement. This study proposes a speech-based LLM reading comprehension chatbot conceptual framework that integrates educational theory with conversational AI. Grounded in cognitive models of reading comprehension, reading literacy, and questioning strategies, The framework enables students to engage in spoken interaction with the chatbot while reading their print books, thereby enhancing comprehension through dialogue rather than relying on screen-based reading. The proposed conceptual framework provides a foundation for future development and empirical validation of speech-based reading chatbots. By bridging reading pedagogy and LLM technology, it contributes to reimagining reading comprehension as an interactive, speech-mediated learning process rather than a screen-bound learning activity.*

Keywords: Reading Comprehension, Language Learning, AI in Education

1. Introduction

Previous chatbot-assisted reading systems have predominantly relied on screen-based interfaces. These digital chatbots have demonstrated positive impacts on reading education in both cognitive and non-cognitive domains. Specifically, they have been shown to enhance students' vocabulary, reading skills, and self-regulated reading strategies, while also boosting confidence, interest, and the willingness to read (Behforouz & Ghaithi, 2024).

Despite the ubiquity and functionality of screen-based digital reading, its impact on reading comprehension is not entirely positive. Research indicates that print reading often promotes comprehension development more effectively than digital formats. From the perspective of Cognitive Load Theory, digital reading imposes a higher cognitive workload compared to paper-based reading (Wästlund et al., 2005). This increased load can negatively affect comprehension, leading to less accurate information judgment and hindering readers' ability to monitor their own reading processes (Clinton, 2019). Furthermore, prolonged screen exposure has been associated with lower academic performance and potential mental health issues (Grant et al., 2019).

To mitigate these issues, shifting from a purely visual interface to a multimodal approach offers significant cognitive advantages. According to the Modality Principle in multimedia learning, students learn better when verbal information is presented auditorily as speech rather than visually as on-screen text (Moreno & Mayer, 1999). Unlike purely visual screen reading, which risks overloading the visual processing channel, a multimodal approach utilizing voice communication aligns better with human cognitive architecture. By offloading some processing to the auditory channel, this method potentially reduces extraneous cognitive load and facilitates deeper learning (Wästlund et al., 2005).

Technological advancements have made this shift feasible. Large Language Models (LLMs) are no longer limited to text-based interactions but have expanded into the realm of multimodal communication. Models such as GPT-4o and Doubao demonstrate impressive voice-interaction capabilities, emulating human-like qualities in prosody, pausing, and emotional expression (Zhang et al., 2025). This evolution opens new possibilities for reading education, providing a rich, untapped area for exploration.

However, the integration of generative AI into education is not without concerns. Studies suggest that overreliance on AI may encourage plagiarism, inhibit critical thinking, and reduce the human interaction essential for effective learning (Lim et al., 2023). Moreover, while non-cognitive aspects of AI tutoring have been widely studied, there is a lack of systematic exploration regarding its impact on the cognitive aspects of reading comprehension.

These challenges and opportunities prompt a re-evaluation of reading support systems. There is a need for a design that combines the cognitive benefits of print reading with the interactive capabilities of AI. Therefore, this study proposes an LLM-based agent that relies on speech interaction, enabling students to focus on print books while communicating through an auditory chatbot.

The research questions of this study are:

RQ1: What are the design principles for a framework of speech-based interaction tutoring aimed at supporting reading comprehension?

RQ2: How can educational theories be effectively integrated into this technological framework to enhance students' reading comprehension?

2. Related Work

2.1. Applications of LLMs in Reading Comprehension

The integration of LLMs into reading education has expanded rapidly. Current applications can be categorized into three primary areas: content generation, tutoring system design, and comprehension assessment.

Content Generation. LLMs are increasingly used to adapt reading materials to students' proficiency levels. Mo and Hu (2024) proposed a multi-agent framework utilizing LLMs to adjust text readability based on teacher requirements and expert feedback. Similarly, Fang et al. (2025) introduced a multi-agent system with roles such as content simplifier and logic analyst to produce high-quality, adaptive texts. These studies confirm LLMs' capability to provide personalized reading resources.

Tutoring Systems. LLM-based chatbots serve various scaffolding roles, including tutors, peers, and companions. Xu et al. (2021) demonstrated that conversational agents acting as tutors could effectively guide students through storytelling and comprehension questions. Kim (2013) designed a digital peer to model effective questioning and provide emotional support. Other studies have explored hybrid roles; Zhang et al. (2022) developed a collaborative storytelling approach for parent-child reading, while Tegos and Demetriadis (2017) created facilitator agents. Additionally, Liu et al. (2024) implemented a "learning-by-teaching" chatbot with a battle mechanism to boost engagement. However, while these systems offer diverse interaction modes, their pedagogical designs for reading comprehension often remain simplistic and lack a strong systematic theoretical foundation.

Comprehension Assessment. Recent research supports the use of LLMs for assessing reading proficiency. Jain et al. (2025) validated LLMs' ability to estimate the difficulty of comprehension questions using the SARA dataset. For more complex tasks, Henkel et al. (2023) found that LLMs could evaluate open-ended questions with accuracy comparable to human experts. Furthermore, Cohn et al. (2024) utilized Chain-of-Thought prompting to enhance evaluation precision. These findings suggest LLMs are viable tools for automated reading assessment.

2.2. Learning Outcomes of LLM-Based Chatbots

Research on the impact of LLM-based chatbots focuses on two dimensions: cognitive and non-cognitive outcomes.

Cognitive Dimension. Studies indicate positive effects on specific reading skills. Behforouz and Ghaithi (2024) found that generative chatbots significantly improved skimming and scanning skills. In early childhood education, Yuan et al. (2025) reported that chatbot interactions supported vocabulary acquisition and character recognition. Notably, Cheng et al. (2024) employed a voice-based embodied chatbot for preschoolers, enhancing vocabulary and comprehension. Despite these successes, existing research on cognitive outcomes tends to be fragmented, lacking a systematic evaluation of hierarchical reading comprehension dimensions.

Non-Cognitive Dimension. There is substantial evidence regarding affective benefits. Liu et al. (2022) and Liu et al. (2024) observed significant improvements in reading interest and engagement among students interacting with chatbot companions. Zheng (2024) further demonstrated that chatbot usage reduced foreign language anxiety, thereby indirectly supporting reading development.

Summary and Research Gaps. Despite the progress, significant gaps remain: (i) **Lack of Systematic Theoretical Design:** Many technical implementations neglect educational theory, resulting in unsystematic designs that fail to address the multi-level nature of reading comprehension. (ii) **Scarcity of Specialized Dialogue Data:** There is a lack of tutoring dialogue datasets specifically structured for reading instruction strategies. (iii) **Underexplored Modality:** Most systems rely on screen-based text interaction. The potential of speech-based agents to reduce visual load and support print reading remains highly underexplored.

3. The Educational Theoretical Framework

To systematically foster reading competence and reecho our RQ1, we establish a coherent framework progressing from abstract cognitive models to concrete questioning strategies (see Table 1). This framework integrates cognitive science perspectives, literacy assessment standards, and pedagogical questioning techniques.

Cognitive Models of Comprehension. Kintsch's (1998) Construction-Integration model delineates comprehension into three layers: the Surface Level, Textbase Level, and Situation Model. Aligning with this cognitive view, Basaraba et al. (2013) operationalized reading comprehension into a hierarchical framework consisting of literal, inferential, and evaluative comprehension. This hierarchy serves as the theoretical backbone for our system's design.

Reading Literacy Standards. Translating cognitive theory into educational goals, we adopt the framework from PIRLS (Progress in International Reading Literacy Study). PIRLS emphasizes the textbase and situation model levels (Sabatini et al., 2024) and identifies four key processes for its 2026 evaluation: (i) retrieving explicit information, (ii) making straightforward inferences, (iii) interpreting and integrating ideas, and (iv) evaluating and critiquing content. These processes define the specific competencies our system aims to train.

Questioning Strategies. To scaffold these competencies, we employ structured questioning strategies. Barrett (1968) originally categorized questions into literal, inferential, and assimilative types. Building on this, Goldman and Durán (1988) proposed a more granular taxonomy essential for automated tutoring. Their framework spans five levels: (i) verbatim retrieval, (ii) paraphrasing explicitly stated ideas, (iii) verbatim comparison, (iv) cross-paragraph integration, and (v) reasoning and application. This progression from simple retrieval to higher-order synthesis provides the specific logic for our chatbot's dialogue generation.

Table 1. Theoretical Model of Reading Comprehension

Cognitive Model of comprehension	Reading Comprehension	Reading Literacy	Question Categories
Surface level	Literal comprehension,	Focusing on and retrieving explicitly stated information	Verbatim literal question
			Paraphrased question
Textbase level	Inferential comprehension	Making straightforward inferences	Comparison and inferential question
		Interpreting and integrating ideas and information	Integrative question
Situation level	Evaluative comprehension	Evaluating and critiquing content and textual elements	Reasoning, evaluative question

4. Framework of the Proposed Reading Comprehension Chatbot

4.1. Application Architecture

As illustrated in Figure 1, the proposed framework functions as a voice-based intelligent reading tutor, enabling students to engage in natural language dialogue while focusing on printed texts. The core of this system is a Multi-Agent Large Language Model (LLM) structure, designed to simulate the pedagogical roles of a human teacher. This architecture is proposed in response to our RQ2.

The architecture consists of three primary interaction layers: (i) Student-System Interaction: Learners communicate verbally with the system via a smart speaker. This screen-free interaction minimizes digital distraction, allowing students to concentrate on the physical book. (ii) Multi-Agent Core: The backend employs specialized LLM agents—specifically a Tutor Agent and an Evaluator Agent—that collaborate to deliver pedagogically grounded instruction. (iii) System Feedback: The system outputs analysis data to a teacher dashboard, providing educators with insights into student performance.

This architecture is specifically designed to scaffold learners through the three cognitive levels defined in our theoretical framework: literal, inferential, and evaluative comprehension.

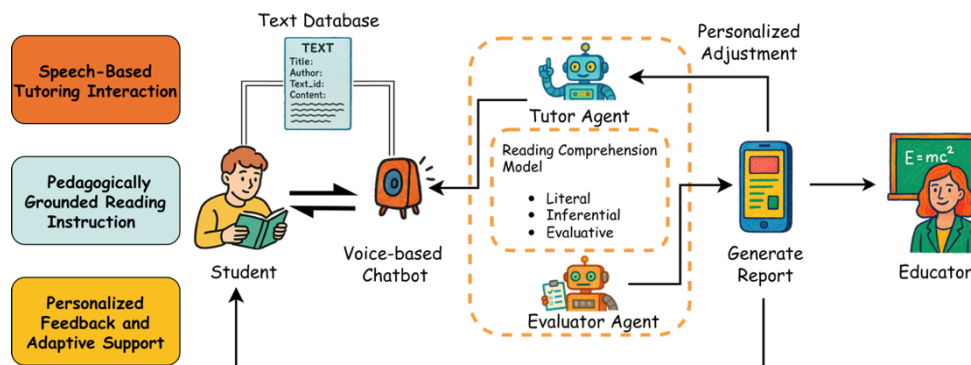


Figure 1: The Designed Application Framework of the Speech-Based Reading Comprehension Chatbot

4.2. System Implementation Pipeline

To operationalize this framework, we established a technical pipeline consisting of five distinct phases, moving from data infrastructure to agent deployment (see Figure 2).

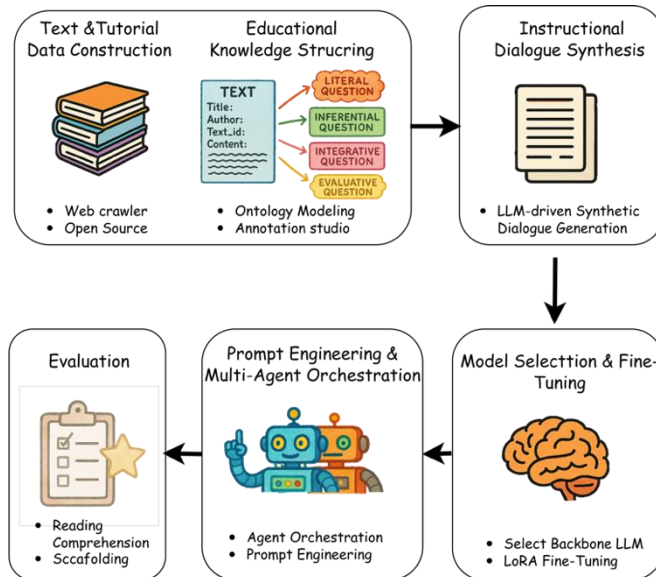


Figure 2: Technical Implementation Route of the Proposed Framework

Phase 1: Educational data construction and knowledge structuring. Since generic LLMs lack specific pedagogical expertise, we first constructed a specialized Educational Knowledge Base anchored in a deep dialogue dataset of approximately 600 texts from the complete Chinese K-12 language curriculum. This process involved indexing reading materials with metadata (e.g., ID, genre, complexity) to enable precise text recognition. Crucially, we performed pedagogical annotation by structuring the knowledge base according to our theoretical framework, mapping specific text segments to constructs such as Kintsch’s situation models or Goldman & Durán’s question types. This ensures the chatbot’s inquiries are grounded in educational logic rather than random text generation.

Phase 2: Dialogue synthesis and dataset enrichment. Addressing the scarcity of authentic tutoring datasets (Fateen & Mine, 2024), we employed a hybrid data strategy. We synthesized high-quality dialogue examples that model ideal tutor-student interactions across different comprehension levels. This synthetic data was combined with real-world educational dialogues to create a robust corpus, ensuring the system can handle diverse student responses, ranging from partial answers to complex misconceptions.

Phase 3: Model Selection and Pedagogical Fine-Tuning. To bridge the gap between general language capabilities and specific educational requirements, we selected the DeepSeek-R1-Distill-Qwen-7B model as our base architecture due to its balance of reasoning capability and computational efficiency suitable for educational deployment. We employed Low-Rank Adaptation (LoRA) for parameter-efficient fine-tuning on our enriched dataset. This process specifically optimized the model’s ability to adhere to the pedagogical constraints defined in Phase 1, ensuring the model prioritizes Socratic questioning over direct answering and aligns its output tone with a supportive, scaffolding-oriented tutoring persona.

Phase 4: Prompt Engineering and Multi-Agent Orchestration. The fourth implementation integrates rigorous prompt engineering within a multi-agent architecture. We utilized System Prompts to enforce a Scaffolding Protocol, forbidding direct answers and guiding the model to provide hints aligned with the Zone of Proximal Development (ZPD). Level-specific templates were designed for literal, inferential, and evaluative dimensions to operationalize the multi-level reading framework. The system deploys two distinct agents: a Tutor Agent responsible for the real-time conversation loop and adaptive scaffolding, and an Evaluator Agent that employs Chain-of-Thought (CoT) prompting to “think step-by-step”—identifying core concepts and comparing them against text evidence—to assess comprehension depth and generate detailed performance reports for the teacher dashboard.

Phase 5: Multidimensional Evaluation. We implemented a two-stage protocol to ensure robustness and efficacy. Stage 1 (Machine Validation) utilizes a fine-grained rubric to assess Cognitive Alignment (across Literal, Inferential, and Evaluative levels), Factuality, and Scaffolding Effectiveness (guidance without answer-revealing). Stage 2 (Pedagogical Impact) validates learning outcomes through a quasi-experimental study, employing pre/post-tests and engagement metrics to quantify gains in reading comprehension and student motivation.

5. Contribution and Future Work

This study contributes a novel framework that integrates speech-based interaction with multi-tiered reading comprehension theories. By utilizing natural voice dialogue, the system reduces interactional friction and supports inclusive learning, allowing students to maintain focus on the text. Pedagogically, it aligns with established theories to scaffold reading development across literal, inferential, and evaluative levels, effectively operationalizing human-like tutoring at scale.

Future work will proceed in two directions: first, transforming this conceptual framework into a functional educational application based on the proposed technical route; and second, conducting empirical validation through controlled studies to gather educational evidence regarding the system's impact on comprehension performance and cognitive engagement.

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Strand

Digital Humanities

數碼人文

Using Digital Human Story Creation Approach to Foster Secondary School Students' AI Literacy And Psychological Well-being

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ABSTRACT

This research study explores the integration of digital humans (artificial intelligence virtual avatars) through intergenerational learning. Our research invited Hong Kong secondary school students (n=25) and senior citizens (n=10). Through a structured 15 hours session program (n=6), participants engaged in a digital human life storytelling project where students digitally replicated the life stories of elderly individuals. This innovative approach fosters meaningful connections between generations and enhances students' digital human literacy and overall emotional, mental, and psychological well-being and sense of achievement, personal growth, and purpose in life. Our pilot study adopted a mixed method (i.e., interview and evaluation form as a survey) to understand students' and elders' AI literacy and psychological well-being through the process of interacting with, understanding, evaluating, and ultimately creating a digital representation of an elderly person's life experiences. The uniqueness of the sessions includes storytelling techniques, technical skills for avatar creation, and ethical considerations surrounding digital human technology. Both co-create verbal and digital narrative stories to achieve virtuality. To review participants' interviews, though collaborating with elderly participants, secondary school students gain insights into understanding more perspectives of senior citizens, fostering their personal growth, resilience, empathetic, and smart aging. Eventually, they increased their digital human literacy and enriched their psychological well-being through the life stories they created. This intergenerational learning approach not only prepares both the old and young for smart aging and an AI future but also promotes well-being through meaningful social engagement, inclusion and bring new trend of applying AI use to the education professional.

KEYWORDS

AI Literacy, Cross-generation collaboration, Intergenerational learning, Social Inclusion

Enhancing Students' EFL Vocabulary and Grammatical Accuracy Through WeChat Reels-Based English Content

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Abstract: *This study examines the effectiveness of English content delivered through WeChat Reels to improve vocabulary and grammatical accuracy among non-English-speaking university students in China. The growing daily access to WeChat reels post for language learning underscores its effectiveness in combining immersive bite-sized content with interactively and linguistically authentic features, making it a favoured platform for learners seeking dynamic and culturally contextualized knowledge. The study employed a mixed-method design. Based on the Technology Acceptance Model (TAM), a questionnaire was administered to 100 students from a university in southwestern China. Also, pre- and post-tests were assigned to evaluate participants' vocabulary and embedded grammar performance after experiencing WeChat Reels-based English content learning intervention. Data analysis included Pearson correlation and paired-sample t-tests, using SPSS (version 27). The intervention proved effective as students' success in vocabulary and embedded grammar writing performance increased from $M=12.30$ in the pre-test to 16.40 in the post-test, indicating a statistically significant gain of the treatment ($p\text{-value}=0.001$). The survey findings indicate that WeChat Reels-based English learning holds promise and is easy to use as a tool for improving receptive and productive English skills. This study offers practical implications regarding the principles of multimedia learning in foreign languages, providing actionable strategies such as generating learning activities useful for informal English language teaching and learning. Meanwhile, the situated learning theory was integrated to apprehend WeChat Reels-based intervention.*

Keywords: WeChat, Reels, Vocabulary, Grammar, EFL

1. Introduction

Social media has become the primary means of daily interaction and connection in the present day. English, both spoken and written, is regarded as the lingua franca and is frequently the main language of communication on social media sites, such as Twitter, Facebook, WhatsApp, TikTok (Al-Smadi, 2013). This into consideration, researchers have strived to address various challenges that most students face when situationally learning English vocabulary and grammar through mobile assisted social media platforms. In line with this, WeChat is one of social media which is nowadays actively used by university students and serves as a form of scaffolding in language learning as almost everyone has a smartphone in mainland China (Hui et al, 2023). With highly advanced technology in China, WeChat offers audiences various linguistic activities (Chen and Zhan, 2020; Fan, 2023). Although WeChat is an immensely popular social media networking application involving several features (Weiming Liu, 2024), such technology cannot be a goal in itself, as long as students continue struggling to acquire and use academic vocabulary and embedded contextualized grammar authentically. Therefore, holistic integration of this technology in learning and teaching is necessary. That said, the current study on investigating non-English-speaking students' perceptions of WeChat Reels-based English learning content practically helps shape the way that instructional materials and strategies are created to assist higher educational students in learning how to use WeChat to enhance their English language vocabulary and grammatical accuracy immersively, with regard to lexical ambiguity which results from receptive and productive word knowledge (Nation, 2022). Remarkably there is a paucity of studies on learning English through WeChat in international databases (Wang & Jiang, 2022), especially in the area of vocabulary and grammar. Most research on related accounts has been conducted by Chinese overseas in the Chinese language environments, despite the growing global use of WeChat for educational purposes (Miller, 2021). This is because the WeChat application is most commonly used in Chinese-speaking regions for teaching and learning purposes in mainland China (Kim, 2022; J. Wu, 2018). Three research questions guided the study:

1. To what extent can WeChat Reels-based English content significantly help mediate university students' vocabulary and embedded grammar performance test scores?
2. What are non-English-speaking students' perceptions of using WeChat Reels to learn English vocabulary and grammar?
3. How does WeChat Reels-based English content impact higher education students' EFL vocabulary and grammatical accuracy?

2. Literature Review

2.1. WeChat social media

Regarding WeChat social media, it is a mobile messaging application launched in January 2011 under a Chinese ‘Tencent Holdings Limited’ firm. By 2018, WeChat application exceeded one billion users (Tencent, 2018), a considerable increase from previous years. WeChat is currently one of the multi-functional social networking platforms globally, placing sixth in terms of active users, with over 1.38 billion monthly active users as of the end of March 2025 (Statista, 2025). In social media usage, the major features of WeChat include messaging services among individuals, sharing pictures and videos through the moments feature, making voice or video calls, and other core features (Montag et al., 2018). Huang (2019) used Wang’s (2013) WeChat support functions and design principles as the basis of WeChat-based connectivism framework to explain its three usage dimensions (basic function, moments, and WeChat platform).

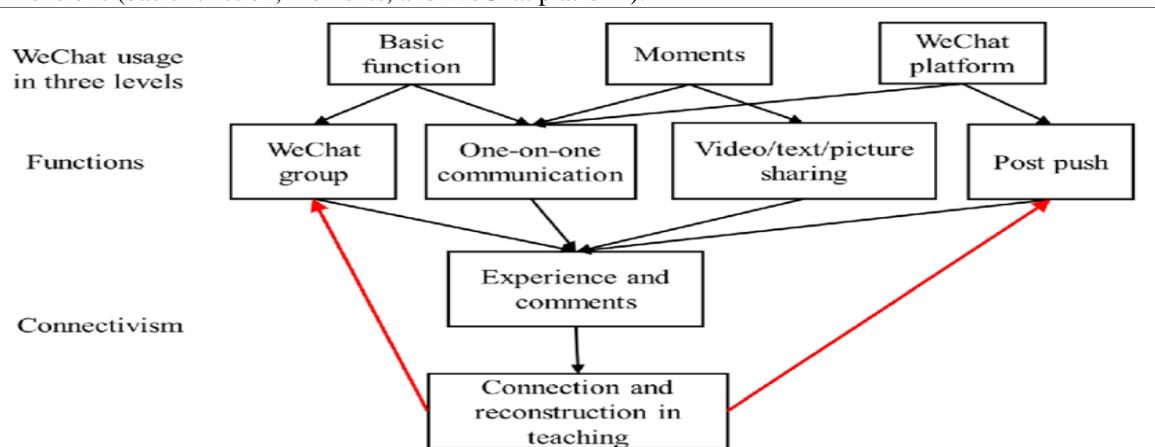


Figure 1. WeChat-based connectivism revised WeChat support functions/design principle framework (Wang, 2013)

2.1.1. WeChat for Learning English Vocabulary

According to Al-Ali (2014), exposure to the usage of English language in a range of media, settings and conditions influences vocabulary growth. An adaptive environment on social media enables students to encounter several words without being pressured to memorize them. For instance, posts published on social media platforms, such as Instagram, WeChat, teach learners the need of reading fresh content. Language acquisition could help who reads for fun or amusement. Liu’s (2023) analysis of the reviewed literature indicated that the use of WeChat for language acquisition has surfaced as a prime tool. Another study validated several widely used platforms in China, providing substantial advantages in facilitating university English courses (Wei, 2020). Although it seems unclear whether using WeChat can help higher education students become more proficient in the English language, the results of Li et al.’s (2021) study suggested using WeChat-based mobile-assisted language learning programs to teach and learn vocabulary on a large scale. Furthermore, Li and Lontas (2023) explored the impact of WeChat on English vocabulary acquisition, especially vivid phrasal (VP) idioms among Chinese EFL learners. The results showed that WeChat users greatly improved their idiomatic competency by learning post-lexical VP idioms. Namaziandost et al. (2021) investigated the effects of teaching vocabulary on Iranian EFL learners using WeChat, finding out that WeChat group fared better than the control group in the post-intervention evaluation. The study showed that mobile apps like WeChat can improve vocabulary in language instruction by providing adaptable contextually adaptable activities and offering adaptable, interesting and cooperative learning opportunities.

2.1.2. WeChat used for learning English grammar

Studies insighted the efficacy of WeChat-supported peer feedback in improving grammatical competency. For instance, a systematic review by Rezai et al. (2023) reported that peer input on WeChat has a considerable impact on several areas of English writing, such as grammar and style, while facilitating prompt and helpful corrections among peers. According to Wang and Crosthwaite (2021), Chinese EFL learners in private tutoring settings found themselves improving their English skills, such as grammar and enunciation. The platform features the capacity to cancel, recall, and re-report messages—enabled freshmen to screen and revise their spoken output, fostering extra grammatical accuracy through self-correction and reflection. This evidence shows that WeChat voice messaging can support grammar improvement in a private-tutoring context. In addition to encouraging students to produce grammatically coherent speech within a constrained timeframe, Xue & Churchill (2019) acknowledge that integrating WeChat into massive open situational learning is a paramount demand for simulating real-life communication scenarios. The educational affordances provided by WeChat are outlined in various academic frameworks, which include resources sharing, collaboration and motivation, essential for efficient grammatical learning. Sun et al. (2023) examined the transformative power of WeChat for peer feedback in EFL writing, revealing substantial gains in grammar and overall writing quality. The platform’s intuitive user interface not only encourages active commitment but also enhances students’ access to and the effectiveness of the feedback loop. This evidence underscores the pivotal role of WeChat in elevating the standards of EFL writing, making it an indispensable tool for language learning. Likewise, Wang (2021) noticed that students prefer to utilize WeChat for self-instruction in oral English. To maximize these social media applications and so understand consequences, Arientini et al. (2021) advise that further research need to be systematically conducted.

2.2. Theoretical foundation

This study that helps understand higher education students' perceptions of WeChat Reels-based English learning content to enhance their vocabulary and grammatical accuracy, offers a meaningful theoretical contribution by applying and extending the components of situated learning theory (Lave & Wenger, 1991). The current study extends situated learning theory (SLT) by demonstrating how English grammatical rules can be integrated into vocabularies while being learned or taught in a genuine communicative situation rather than through isolated form-focused instruction. WeChat Reels as embedded streaming communities of knowledge sharing and practice between native and non-native English speakers seamlessly facilitate English language learners' engagement as apprentices in a socially constructed practice context. This is because language is transferred and received through its embeddedness and situatedness on WeChat. Since language learning is closely connected to social interaction and cultural context, socialization is an essential component of it. The theory concludes that people learn more than just grammar and vocabulary of a given language, they also learn how to use it correctly in their social, communicative and cultural contexts.

3. Methodology

3.1. Design

This study used a mixed method, combining a quasi-experimental repeated measure design with a single group of participants involved in pre-and post-tests, and an online questionnaire through WeChat. The quantitative survey analyzes psychological, social and educational aspects, using numerical data (Hashim, 2022). In conformity with informal education settings and volunteer-based studies, a mixed method design was proven to be appropriate.

3.2. Participants

One hundred undergraduate and graduate participants from non-English-speaking countries, likely Chinese and international students from a given university in a southwestern province of China responded voluntarily to the call for participants through the WeChat application. Fifty-nine males and forty-one females aged 18 and over 25 years, with various fields of study and English proficiency levels, such as A1 (beginner), A2 (elementary), B1 (intermediate), B2 (upper-intermediate), C1 (advanced) and C2 (proficient) referring to the Common European Framework of Reference for Language (CEFR), participated in the research tasks.

3.3. Instruments and data collection procedure

3.3.1. Pre- and post-tests

Ten willing participants at various English proficiency levels underwent pre- and post-tests. The pre-test phase involved shared book reading and an audio tape, including vocabulary and grammatical items from the Chinese nationally planned textbook for undergraduate education, "*New Century College English Learning To Speak: An English Video Course*" (3rd Edition). Participants were expected to grasp the lesson content on 'My favorite pastimes', especially the sports vocabulary unit and contextualized grammar. The materials used for vocabulary and embedded grammar emphasized subject-verb agreement, word order, and other grammatical rules in sentences, such as 'action verb + lexical unit' vs 'non action verb + lexical unit' or 'action verb + gerund lexical unit' vs 'non action verb+ gerund lexical unit'.

WeChat Reels-based intervention lasted for two weeks and was introduced daily to the participants. It involved searching appropriate WeChat reels about English vocabulary and grammar with subtitles to be scanned for long-term memory retrieval. To achieve this, a search was conducted in the WeChat channel section engine, using general and specific keywords, such as "Ice skating", "Go swimming", "Sport vocabulary", and others. Out of a thousand WeChat reels found, ten featuring sports were selected based on the most views, likes, and comments criteria. The ten reels served for acquiring and replicating vocabulary and contextualized grammar before the paper-based post-test.

The test was validated by two highly qualified instructors of English. The performer earned one mark for each word used upon lexical, grammatical and contextual completion, but failed to do so, resulting in the loss of one mark on a scale of 20 marks based on the Common European Framework of Reference for language assessment.

3.3.2. Likert scale online questionnaire

A quantitative investigation was conducted using the WeChat online application to collect information on learners' perceptions and the effectiveness of using WeChat Reels-based English vocabulary and contextualized grammar learning. A 4-point Likert scale multiple-choice questionnaire ranging from 1=strongly agree, 2=agree, 3=disagree, and 4 = strongly disagree was designed based on Hashim's questionnaire (2022). Respondents only had to choose one option.

3.4. Data Analysis and Procedure

3.4.1. Pre- and Post-tests analysis

Pre- and post-test design was used to assess the participants' vocabulary and contextualized grammar performance. SPSS (version 27) was used to analyze the repetitive data and efficiently validate the results. Data analysis procedures included t-

tests, paired samples t-test and paired samples effect sizes to compare the pre- and post-test scores, showing the (non-) significance difference between two paired measurements (pre-test and post-test scores).

3.4.2. Likert scale questionnaire analysis

The online questionnaire focuses on the Pearson correlation to examine (a) the relationship between WeChat Reels content and English vocabulary enhancement and (b) WeChat Reels-based English content and grammar improvement.

4. Findings

4.1. Students' Performance Before and After WeChat Reels-Based Intervention

Table 1. Participants' Pre-Post Tests Scores and Letter Grades

Participants	PreTScore	GradePret	PostTScore	GradePost
P1	14	C-	17	B
P2	08	F	12	D-
P3	15	C	19	A
P4	12	D-	16	B-
P5	10	E-	15	C
P6	14	C-	19	A
P7	11	E	17	B
P8	12	D-	15	C
P9	14	C-	16	B-
P10	13	D	18	A-

Table 2. Paired Samples Correlation

	N	Correlation	Sig.
Pair 1 PreT & PostT	10	0.84	0.002

Table 3. Paired Samples T-Test on Pre-test and Post-test Scores

		Paired Differences							95% Confidence Interval of the Difference
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	PostT- PreT	4.10	1.19	0.37	3.24	4.95	10.83	9	<.001

4.2. Relation between Students' Perception of WeChat Reels-based content and English Vocabulary Enhancement

Table 4. Pearson correlation results for students' perception of WeChat Reels and English vocabulary enhancement

		Students' Perceptions of WeChat Reels	English Vocabulary Enhancement
Students' views of WeChat Reels	Pearson Correlation	1	.846**
	Sig. (2-tailed)		<.001
	N	100	100
English Vocabulary Enhancement	Pearson Correlation	.846**	1
	Sig. (2-tailed)	<.001	
	N	100	100

** . Correlation is significant at the 0.01 level (2-tailed).

4.3. Relation between Students' Perception of WeChat Reels-based content and English Grammar Improvement

Table 5. Pearson correlation results for students' perception of WeChat Reels and English embedded grammar improvement

		Students' Perceptions of WeChat Reels	English Grammar Improvement
Students' views of WeChat Reels	Pearson Correlation	1	.874**
	Sig. (2-tailed)		<.001
	N	100	100
English Grammar Improvement	Pearson Correlation	.874**	1
	Sig. (2-tailed)	<.001	
	N	100	100

** . Correlation is significant at the 0.01 level (2-tailed).

5. Discussion

5.1. Discussion on RQ1 findings

Based on the RQ1, the research under examination demonstrates that WeChat Reels-based English may significantly improve grammar and vocabulary scores of students. This fits with larger studies on how social media and digital channels help to accelerate language acquisition. Accessible, interesting, and interactive settings offered by social media sites like WeChat have greatly changed language acquisition (Liu, 2023). Different social media sites have successfully advanced English language instruction throughout the COVID-19 epidemic by improving writing, reading, listening, and grammar abilities (Muftah, 2022). Offering pupils encouragement and exposure to varied language inputs, these platforms foster an interesting digital environment ideal for learning (Sidgi, 2024). Likewise, this study's findings align with previous research showing the positive influence of mobile-assisted language learning (MALL) approaches on language learning outcomes among university students (Yu, 2021), particularly in terms of lexical acquisition (Lin & Lin, 2019). The results of this research on students' vocabulary and grammatical accuracy performance outcomes after incorporating WeChat-Reels-based English content in learning vocabulary and grammar further corroborate the widespread positive effects of employing mobile technologies for language learning reported in the relevant literature (Su & Zou, 2020). WhatsApp, for example, has been used to enhance L2 speaking abilities; statistical substantial gains in fluency, coherence, vocabulary resources, and pronunciation were observed (Akkara et al., 2020). Another study stresses this entwined character of linguistic abilities in academic evaluations (Curle et al., 2024) match this relationship. In this situation, the WeChat-assisted language learning brought about substantial differences in the students' positive mediated test scores. This outcome sides with the assertion that mobile-based tools impact vocabulary acquisition (Lin & Lin, 2019). The findings also aligned with Namaziandost et al.'s (2021) study on the effects of teaching vocabulary on Iranian EFL students where an experimental group that received vocabulary instruction using WeChat outperformed the control group.

5.2. Discussion on RQ2 findings

The findings of RQ2 showed that the majority of respondents (88%) found WeChat Reels easy to use. This suggests that the platform interface is user-friendly, reducing the cognitive effort required for navigation and engagement. Such ease of use is pivotal in educational technology as it enhances learners' willingness to adopt digital tools (Chan & Hu, 2023). This high usability rating supports the recent findings of Wang and Chen (2020) about the intuitive design of bite-sized video content platforms for educational purposes. Also, 46% of participants acknowledged the usefulness of WeChat Reels in learning new vocabulary and grammar, supporting the idea that short videos serve as effective micro-learning tools. This is consistent with prior research indicating that short videos enhance engagement and knowledge retention in language learning (Zhang & Zou, 2022). Participants exhibited a favorable attitude toward WeChat Reels, with 54%, expressing a fond expectation of its integration into formal learning. Such a deliberate disposition is crucial as students usually display a positive attitude toward using web-based or online resources for language learning since they support personalized learning environment and directly influence behavioral intentions (Masalimova et al., 2024). An overwhelming 73% of the student participants reported using WeChat Reels in well-defined learning contexts, suggesting that the platform is actively utilized for grammar and vocabulary practice. This supports the notion that short-form video platforms can supplement traditional language instruction by providing authentic, contextualized input (Sarangapani & Hashim, 2022). These results demonstrate how WeChat Reels' format capitalizes on dual coding theory (Mayer, 2021), combining visual and verbal information for enhanced retention. Although technology-based learning tools like WeChat Reels has enormous potential to improve English learning via engaging, situational learning experiences, research critically show the need to consider the educational and psychological effects of these technologies (Fošner, 2024).

5.3. Discussion on RQ3 findings

The findings of RQ3 on the impact of WeChat Reels-based English content on higher education students' EFL vocabulary and grammatical accuracy align well with Davis's (1986) Technology Acceptance Model (TAM), emphasizing perceived usefulness as a key determinant of WeChat technology adoption in educational contexts (Al-Emran et al., 2020). The overwhelming positive perception of WeChat Reels based English learning (98%) supports findings on the effectiveness of short-video platforms in vocabulary acquisition by Zou and Xie (2021), while participants' agreement (71%) on improving English grammar through WeChat Reels corroborates Hashim's (2022) research on incorporating Instagram-based reels to enhance students' English skills. The role of digital activities in vocabulary acquisition has been emphasized in various studies. A study on extramural vocabulary acquisition from digital activities showed learners gain substantial knowledge over time with digital interaction playing a pivotal role (Laufer & Vaisman, 2023). This suggests that WeChat Reels, like other digital platforms, provide an informal effective environment for incidental learning where vocabulary is acquired through exposure to content. In addition, the use of WeChat Reels based EFL learning aligns with findings that digital media can enhance language proficiency by offering multimodal experiences that promote both vocabulary recognition and application (Fengyu, 2023). This mode of learning not only supports vocabulary expansion but also assists in the assimilation of grammatical structures, potentially through repeated exposure to linguistic patterns. This is further supported by Li's (2023) case study of WeChat-assisted English vocabulary acquisition in Chinese higher education to repurpose English language learning for different linguistic contexts. Situational learning and technology-assisted methods have been recognized as a potent tool to contribute to language skills acquisition and practice, promoting for example active vocabulary application by integrating language experiences into real-life contexts (Fengyu, 2023). This suggests WeChat reel-based vocabulary and grammar learning, with its interactive capabilities, can bridge the gap between passive exposure and active language usage.

6. Practical Contribution

This research offers some helpful recommendations for receptive and productive English vocabulary and grammar abilities, grounded in the principles of multimedia in foreign languages (Lee & Mayer, 2018). To begin with the principle of generative activity, the study encourages language learners to pause WeChat reels after a while to conceive the scenario. Replicating the instructor's knowledge presentation and posting it on WeChat channel is a way to foster receptive and productive skills. Considering that contextualized grammar is embedded in vocabulary, imitation helps learners easily construct the language. In addition to the segmenting principle, the current study recommends breaking down WeChat Reels content longer than one minute into sequences. Throughout the WeChat reels scanning process, writing down essential knowledge results in more understandable input and output after revising the content later. Learners are more likely to grasp the learning materials better if the video is short enough, concise, and aligned with the learning purposes. Finally, on the redundancy and modality principle, contrary to the modality principle that suggests that images must be combined with spoken, involving spoken and written words (subtitles) is highly recommended for long-term learning.

7. Limitations and Future Research Recommendations

The study has primarily limited on higher education because WeChat is more commonly used by students in that demographic in China. Several research avenues could enhance our understanding of WeChat Reels-based English vocabulary and grammar learning within the overall practice, such as monitoring the long-term effects of WeChat Reels-based English vocabulary and grammar language use across various age groups through a longitudinal study.

8. Conclusion

To conclude, this study aimed to examine the three research questions regarding university students' perceptions of WeChat Reels-based English content to enhance vocabulary and embedded grammar accuracy in an informal education context. The first question examined the effect size difference of the measurements before and after the WeChat Reels-based English language vocabulary and grammar learning intervention. The findings concluded that English vocabulary and grammar intervention delivered through WeChat Reels contributed to significant improvements in students' post-test scores compared with those of pre-test. Research question 2 assessed learners' experiences of using WeChat Reels to learn English vocabulary and embedded grammar. The results demonstrate that a sizable portion of higher education students view WeChat Reels as simple to use, highlighting their user-friendly design and capacity to reduce cognitive load, which in turn promotes easier adoption. The findings from question 3 indicated that a notable majority of students regard WeChat Reels as effective in improving their grammatical accuracy and acquiring academic vocabulary, providing positive correlation between the use of WeChat Reels with vocabulary and embedded grammar improvement.

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Gender Differences in AI Image-Inspired Writing Activities: An Analysis Across AI Self-Efficacy, Prompt Ability, Comprehension Ability and Satisfaction

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Abstract: *Generative artificial intelligence (AI) tools such as Microsoft Copilot have introduced new possibilities for language education. In this study, Microsoft Copilot was incorporated into language instruction as a tool for students to generate AI based images and as an inspiration for writing activities. Using Microsoft Copilot, participants generated visual prompts that served as inspiration for written compositions, connecting visual imagination with linguistic expression. This study investigated the relationships among four constructs—AI Self-Efficacy, Prompt Ability, Comprehension Ability and Satisfaction—in the context of AI image-inspired writing activities. This research contributed to the growing understanding of how generative AI can support inclusive, imaginative, and cognitively rich learning experiences in the digital era.*

Keywords: AI Self-Efficacy, Prompt Ability, Comprehension Ability, Satisfaction, Generative Artificial Intelligence

1. Introduction

In 2025, while generative artificial intelligence (AI) has been widely applied in language learning, no research has yet systematically explored how AI-generated images can enhance students' writing performance and creativity in Taiwan. Most existing research focuses on text-based generative models and automated feedback rather than visual generation. For instance, Zhuang et al. (2025) examined the role of AI feedback in picture-cued writing tasks, emphasizing grammatical and lexical correction within text-based contexts. Similarly, Chen et al. (2025) investigated learners' responses to Chat GPT-generated text and videos, focusing on the affective and cognitive engagement of global language learners. However, these studies primarily center on linguistic enhancement through textual interaction. To date, no research has examined how learners generate and interpret AI-produced images as creative stimuli for language composition—an underexplored area this study seeks to address.

Generative AI tools such as Microsoft Copilot enable learners to create images from textual descriptions, transforming the writing classroom into an interactive and imaginative environment. These AI image-inspired writing activities encourage students to interpret visual content, construct ideas, and express emotions through written composition, effectively linking visual imagination with linguistic expression. In Taiwan, educators are beginning to integrate AI-assisted writing in innovative ways—allowing students to visualize story scenes, settings, or characters through AI-generated imagery before composing texts. This process engages image-based thinking, which activates different neural pathways than linguistic thinking, facilitating a visual-to-verbal conversion that stimulates creativity and deeper cognitive engagement.

In language education, creative thinking and written expression are key competencies. According to Díaz and Nussbaum (2024), effective use of AI in classrooms requires not only technological innovation but also *pedagogical intelligence*—the ability to meaningfully integrate technology into teaching to enhance learning outcomes. During adolescence, cognitive and emotional development fosters abstract reasoning, creative problem-solving, and self-reflection (Barbot & Heuser, 2017). These capacities make AI-assisted language learning particularly effective for cultivating imagination, linguistic fluency, and self-efficacy. By bridging human creativity and machine intelligence, AI image-inspired writing activities not only stimulate students' imagination but also promote equity and inclusivity in creative language learning.

Moreover, gender theory provides an important lens for understanding learners' engagement with AI-based educational tools. Prior research suggests that male and female students often differ in technology self-efficacy, motivation, and learning strategies (Kay, 2006). These gendered patterns may influence how students perceive and interact with AI applications in creative contexts, such as image-inspired writing. Incorporating gender perspectives into AI-assisted language learning thus enables a more equitable understanding of how learners with different cognitive and affective orientations respond to multimodal educational technologies.

According to gender theory and cognitive appraisal theory, the following research question is proposed: how do gender differences influence learners' engagement with AI-generated images as creative stimuli in language composition tasks? Specifically, how do male and female students differ in terms of AI self-efficacy, prompt ability, comprehension ability, and satisfaction when using AI-generated images for writing activities? This study aims to fill this research gap by empirically examining these gender-related differences, thereby contributing to the development of more inclusive and effective AI-integrated language learning practices.

2. Methodology

This study used purposive sampling method and collected a total of 245 questionnaire responses, of which 188 were valid, yielding a valid respond rate of 76.7%. Among the participants, 120 were male (63.8%) and 68 were female (36.2%). The participants were elementary students who engaged in AI image-inspired writing activities using Microsoft Copilot as a generative AI support tool. These activities involved students generating AI-based visual prompts and composing written narratives inspired by those images.

The research instrument consisted of a structured questionnaire designed to measure four constructs relevant to AI-assisted language learning: AI self-efficacy, prompt ability, comprehension ability, and satisfaction. Each construct was operationalized through multiple items rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Internal consistency reliability was examined using Cronbach’s alpha coefficients, indicating acceptable reliability.

To examine gender differences across four constructs, an independent-samples t-test was conducted using SPSS statistics. Descriptive statistics, including means and standard deviations, were calculated to summarize students’ affective and cognitive responses. The significance level was set at $p < .05$ to determine whether gender differences were statistically significant.

This methodological design provided a quantitative foundation to evaluate how male and female students differ in their engagement with generative-AI-based language learning tasks, particularly in terms of prompt-generation ability and overall learning perceptions.

3. Result

An independent-samples t-test was conducted to examine gender differences across four constructs: AI self-efficacy, prompt ability, comprehension ability, and satisfaction. The results are summarized in Table 1.

Table 1. Gender differences across constructs.

Constructs	Gender	N	M	SD	t(df)	P
AI Self-Efficacy	Male	120	3.49	0.91	1.20(186)	0.23
	Female	68	3.33	0.85		
Prompt Ability	Male	120	3.73	0.78	2.12(186)	0.04*
	Female	68	3.48	0.82		
Comprehension Ability	Male	120	3.68	0.77	1.58(186)	0.12
	Female	68	3.48	0.90		
Satisfaction	Male	120	3.68	0.83	1.17(186)	0.24
	Female	68	3.53	0.84		

The study revealed that gender differences were largely nonsignificant across most constructs ($p > .05$). For AI self-efficacy, male students ($M = 3.49$, $SD = 0.91$) reported slightly higher mean scores than female students ($M = 3.33$, $SD = 0.85$), though the difference was not significant, $t(186) = 1.20$, $p = .23$. In contrast, a significant gender difference was found in prompt ability, with male students ($M = 3.73$, $SD = 0.78$) outperforming female students ($M = 3.48$, $SD = 0.82$), $t(186) = 2.12$, $p = .04^*$. This suggests that male students demonstrated greater confidence or skill in formulating effective prompts when interacting with AI tools. For comprehension ability, no significant difference was observed between males ($M = 3.68$, $SD = 0.77$) and females ($M = 3.48$, $SD = 0.90$), $t(186) = 1.58$, $p = .12$. Similarly, satisfaction did not differ significantly by gender, $t(186) = 1.17$, $p = .24$, indicating comparable affective engagement among participants. Overall, the results indicate that while male and female students exhibited similar levels of AI self-efficacy, comprehension ability, and satisfaction, a notable gender gap emerged in prompt ability, highlighting a potential area for further pedagogical attention in AI-assisted language learning.

4. Discussion

The findings of this study revealed that gender differences were largely nonsignificant across AI self-efficacy, comprehension ability, and satisfaction, indicating that both male and female students demonstrated comparable cognitive and affective engagement when participating in AI image-inspired writing activities. However, a significant gender difference was observed in prompt ability, with male students outperforming female students.

This difference may reflect variations in learners’ prior exposure to technology and confidence in interacting with AI systems. Male students might possess greater familiarity with formulating commands or instructions for digital tools, which could enhance their ability to generate more effective prompts. Conversely, female students may approach prompt construction more cautiously, focusing on linguistic accuracy rather than exploratory experimentation.

Despite this disparity, the overall results underscore the potential of generative AI to foster equitable participation in language learning. When designed with appropriate pedagogical scaffolds—such as prompt-writing guidance, example-based modeling, and reflective feedback—AI-assisted platforms can help mitigate gender gaps by supporting learners who are less confident in articulating prompts. This implies that instruction in prompt engineering may serve as an essential component in AI-integrated language education, empowering all learners to engage creatively and confidently with multimodal technologies.

Furthermore, these findings highlight the broader role of generative AI in transforming language learning and creative expression. By converting abstract ideas into visual representations, AI systems can stimulate imagination and intrinsic motivation for both genders (Li, Abdullah, & Tse, 2025). In this sense, gender differences in technical prompt formulation do not necessarily translate into disparities in creativity or learning outcomes; rather, they point to diverse interactional styles that educators can address through adaptive feedback and inclusive design.

In conclusion, although prompt ability exhibited a statistically significant gender difference, the overall pattern of results suggests that AI image-inspired writing activities still promote balanced affective engagement and equitable learning opportunities. Future research could further examine how gender-responsive instructional strategies—particularly those focused on prompt design and AI communication skills—might narrow remaining gaps and optimize the educational potential of generative AI.

5. Conclusion

This study examined gender differences in AI image-inspired writing activities across four constructs: AI self-efficacy, Prompt Ability, Comprehension Ability, and Satisfaction. Results revealed a significant gender difference in Prompt Ability, with male students performing better than female students, while no significant differences were found in AI self-efficacy, comprehension ability, or satisfaction. These outcomes suggest that both male and female students generally demonstrated comparable affective and cognitive engagement when using Microsoft Copilot to generate AI-based visual prompts and compose written narratives. However, male students exhibited greater proficiency and confidence in formulating effective prompts, indicating that gender may influence how learners communicate and interact with AI systems.

In response to the research question guided by gender theory and cognitive appraisal theory, this study found that gender differences most prominently affected learners' prompt ability, while other aspects of engagement—such as self-efficacy, comprehension, and satisfaction—remained relatively unaffected. This indicates that while affective and cognitive responses to AI-generated imagery were similar across genders, disparities in generative skill and confidence may reflect underlying differences in prior experience or comfort with AI tools.

The observed difference in Prompt Ability may stem from disparities in prior technological experience, confidence in experimenting with AI interfaces, or divergent communication styles when engaging in open-ended creative tasks. This finding highlights the importance of integrating explicit instruction in prompt engineering within AI-integrated language education. Teachers can provide scaffolded support through modeling exemplar prompts, guiding iterative refinement, and facilitating peer collaboration. Such strategies can bridge skill gaps and ensure that all learners—regardless of gender—engage confidently and creatively with generative AI tools.

Beyond gender differences, this study reaffirms the inclusive and transformative potential of AI image-inspired writing activities in fostering creativity, self-expression, and reflective thinking. When properly guided, generative AI can serve as a cognitive partner that stimulates imagination and supports adaptive learning. By merging technology and creativity, AI provides a dynamic environment where learners develop linguistic confidence, creative problem-solving abilities, and gender-equitable opportunities for multimodal engagement.

Finally, future research could explore how gender-responsive instructional strategies—such as prompt-writing workshops and AI literacy programs—affect learners' engagement and performance. Longitudinal investigations could also examine how prompt ability evolves over time and how pedagogical design influences creativity, critical thinking, and equitable participation in AI-assisted learning contexts.

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虛擬實境教學結合人工智慧學習抽象詞彙--古詩文的創新教學策略

Virtual Reality Integrated Instruction with Artificial Intelligence for Learning

Abstract Vocabulary: An Innovative Pedagogical Strategy for Classical Chinese

Poetry

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【摘要】本研究探討虛擬實境(Virtual Reality)教學與人工智慧(Artificial Intelligence)技術結合對香港小學生學習中國古詩文抽象詞彙的教學策略。傳統教學模式多側重於文本講解，學生難以深入體會詩文的意境與文化內涵，特別當面對古詩文中大量抽象詞彙時，常因缺乏具體感知經驗而未能充分理解其深層意義。抽象詞彙具有多義化、概念化，學生文言語言知識匱乏與文化認知不足進而產生學習障礙。本研究以三所本地小學學生為實驗對象，探討VR-AI教學，如何幫助學生學習古詩文中的抽象詞彙。研究結果將為古詩文抽象詞彙的教學提供創新方案，並為數碼科技與人文教育結合發展提供參考。

【關鍵字】 虛擬實境、人工智慧、中國古詩文、抽象詞彙、教學策略

Abstract: This study investigates the pedagogical strategies of integrating Virtual Reality (VR) instruction with Artificial Intelligence (AI) technology to facilitate the learning of abstract vocabulary found in classical Chinese poetry among primary school students in Hong Kong. Traditional teaching models predominantly emphasize textual exegesis, rendering it challenging for students to deeply appreciate the artistic conception and cultural connotations embedded within these classical works. This difficulty is particularly pronounced when confronting the extensive abstract vocabulary in classical texts, as students often struggle to grasp their deeper meanings due to a lack of concrete perceptual experiences. Abstract vocabulary is characterized by polysemy and conceptualization, and students' limited knowledge of the classical Chinese language and cultural cognition further contributes to learning barriers. Targeting students from three local primary schools as experimental subjects, this research explores how VR-AI integrated instruction can assist students in mastering abstract vocabulary in classical poetry. The findings are intended to provide innovative solutions for teaching abstract vocabulary in classical literature and offer valuable insights for the integrated development of digital technology and humanities education.

Keywords: Virtual Reality, Artificial Intelligence, Classical Chinese Poetry, Abstract Vocabulary, Pedagogical Strategy

1. 前言

在數碼教育快速發展的背景下，虛擬實境(VR)技術為古詩文教學開闢新路徑。中國古詩文具有高度抽象和文化獨特性，對處於具體運思階段的小學生(Piaget, 1970)構成認知挑戰。儘管香港教育局提倡多模態教學策略(張永德, 2023)，但本地小學教師多以傳統方式教授，其存在文化情境靜態化、個性化適配不足等局限。有研究指出 VR 技術能提升學習成效(Chang & Ceng, 2023)，但仍存在兩大問題，即 VR 與 AI 的協同機制模糊，技術整合停留在工具層面，缺乏認知理論指導，以及語言和文化符號適配不足。現有 VR 情境多為通用設計，忽視文化符號的定制設計。基於此，本研究以香港教育局「建議篇章」中的古詩文為例，開發 VR-AI 教案，通過動態情境模擬與個性化反饋，強化本地小學生「感官-文化-語言」的認知鏈條，並採用混合研究方法評估其成效，以期為香港教育局「從閱讀中學習」政策提供實證支持。

2. 文獻綜述

2.1. 抽象語言習得的認知機制

抽象語言作為語言習得中的高階認知部分，其本質在於構建脫離具體感官經驗的符號系統(Vygotsky, 1986)。這種符號系統的核心特徵在於其「去情境化」(Decontextualized)的表徵，即語言符號抽離原始語境而抽象呈現(Gee, 2014)。這使其與文化隱喻深度綁定。當去情境化的符號與特定文化配合時，理解需依賴特定文化共識解碼的隱喻體系(吳為善, 2011)。心理學研究揭示，兒童因其抽象聯結能力尚未成熟，對此類隱喻的處理受心智容量限制，這種限制會影響前額葉皮層(負責抽象整合)的啟動，從而弱化他們對學習抽象語言的興趣(Johnson, 1989)。這些

缺口為技術介入提供了邏輯依據，兒童的抽象聯結能力受神經發展制約，需藉助多感官體驗彌補「去情境化」帶來的理解鴻溝；教學工具若具備「情境重構」與「即時解碼」雙重功能，則能有效幫助兒童了解語言和文化符號。Yang(2022)研究指出，沉浸式 VR 可通過多感官敘事再現詩詞場景，啟動學生的具身化認知。這種技術整合不僅回應了認知發展理論對「文化適配性」的呼籲，更為突破抽象語言學習的障礙（去情境化）提供了可操作的解決路徑。本研究將設計文化適配的 VR 場景，並通過 AI 聊天機提供即時文化解碼，解決「去情境化」障礙。

2.2. 多模態教學的演進

多模態教學的演變歷程本質上是教育技術與認知科學協同進化的過程。從傳統視角看，張永德(2023)提出「聲情策略」與「觸感策略」，通過調動學生的聽覺、觸覺及情感共鳴的結合，初步構建了「感觀-文本」的雙向聯結通道，這在語言習得的基礎感知階段展現出開創性價值。然而，其研究局限在於文化呈現形式的靜態化，難以有效還原和傳遞古詩文中蘊含的動態情境與深層意境，迫使學生需自行尋求相關的知識去填補當中的情感缺口。這無形中增加學生在學習過程中的內在的認知負荷。數碼技術的引入，令傳統多模態的「感觀刺激」升級為「情境具身」。在此背景下，VR 技術通過構建真實的三維場景，將抽象文字轉化為可感知的動態場景，其強大的情境呈現力直接降低了學生理解古詩文意境所需的內在認知負荷。其有助提升學習成效的能力已得到實證研究的驗證，即動態情境能降低認知負荷(Chang & Ceng, 2023)。

然而，現有 VR 技術對於古詩文教學存在局限，如文化符號適配不足，未能系統支撐古詩文複雜意象體系，且忽略學生個體認知能力差異對互動層次的需求。此時 AI 聊天機提供的即時互動，能有效補充 VR 的局限性。VR-AI 的結合，不僅能深度解析古詩文的意象體系，而且能形成互動式教學。VR-AI 的協同形成「情境具身-認知適配」正向互補效應。VR 的沉浸場景降低從文字到情境的轉換成本，實現學生在學習過程中認知負荷的物理性減負；AI 聊天機則為學生提供了學習的個性化支援，達成認知支持的智慧性增值。這種技術耦合將多模態教學從「感官刺激」向「認知協同」範式升級，此雙重作用為古詩文教學的深度情境化與個性化適配開創新可能，實現古詩文學習從「被動解碼」轉化為「具身建構」的深度認知過程。

2.3. 香港本土化教育的挑戰與技術適應性

香港學生在學習中國古詩文時面臨著文言語言知識匱乏與文化認知不足的雙重挑戰。一方面，粵語口語與文言文詞彙語法用法割裂，文言語言知識匱乏，導致文言文詞彙語法理解偏差。Schwanenflugel et al.(1988)指出，抽象詞彙的認知需依賴從具體經驗中提取語境資訊，而古詩文「去情境化」的隱喻特性(Gee, 2014)加劇了這一障礙。另一方面，都市生活經驗與詩中意象脫節，造成文化斷層。Widen 與 Russell(2003)研究顯示，兒童對文化依存式抽象概念的理解準確率顯然低於具象概念。這些挑戰本質上是由抽象語言的「去情境化」特性與學生「文化經驗貧瘠」引致的，而傳統教學難以彌合「文化符號」與「具身認知」的鴻溝。

為回應此障礙，本研究嘗試整合 Barsalou(2008)具身認知理論(感官體驗對認知的基礎作用)與 Vygotsky(1986)的社會文化理論(互動鷹架)，強調學習者需透過情境化體驗與互動式鷹架支持以建構抽象詞彙的認知。技術層面，VR 通過沉浸式場景重構古詩文的文化情境，將古詩詞中的意境還原為可交互的動態環境，啟動學生的視覺、聽覺與空間感知，直接降低理解抽象意境所需的認知負荷；AI 聊天機則模擬教師的互動鷹架動態調整教學深度。此協同機制呼應 Mayer(2021)提出「多模態整合原則」，即視覺、語言、互動的結合，以最大化學習成效。此技術介入不僅彌補香港學生因文化認知不足而產生的認知誤區，更直接呼應香港教育局的政策目標，即「中國語文的學習，應以讀寫聽說為主導，有機地結合其他學習範疇，工具性與人文性並重，全面提升學生的語文素養」。最終實現「感官-文化-語言」的整合認知，為古詩文教學提供創新與可行的實際路徑。

3. 研究問題

本研究聚焦於 VR-AI 教學對香港小學生學習中國古詩文抽象詞彙的差異化效能，研究問題如下：

問題一：採用 VR-AI 的教學方式與傳統教學方式相比，是否會對學生產生不同的影響？

問題二：VR-AI 教學與傳統教學相比，在不同年級學生的學習體驗和效果上有什麼不同？

4. 研究方法

本研究採用混合研究方法，結合實驗設計與質性分析，評估 VR-AI 教學對香港小學生學習中國古詩文的成效。研究對象為三所本地小學學生，分為實驗組(VR-AI 教學)和對照組(傳統教學)。量化數據通過問卷調查；質性數據來自教師訪談與學生焦點小組，以全面評估教學成效。

4.1. 研究對象

本研究參與者來自三所本地小學的學生，共 140 名學生(年級涵蓋一年級、三年級和五年級)及 3 名教師。學生分為實驗組(VR-AI 教學, n=78)與對照組(傳統教學, n=62)，教師均參與實驗組課程教學。

表 1. 參與學生(共計 140 人)

學校類型	年級	實驗組人數	對照組人數	小計
本地小學	一年級	30	26	56
	三年級	22	19	41
	五年級	26	17	43
總計		78	62	140

4.2. 實驗步驟

分三階段漸進式實施教學：

1. 傳統講授：教師解構古詩文(背景脈絡、詩文大意)，輔以靜態圖像讓學生建立基礎認知；
2. VR 具身體驗結合 AI 聊天機：學生通過 VR 眼鏡進入三維詩境空間，在 360°全景中觸發多感官交互，通過場景內嵌的選擇題、問答題，在即時作出回應的同時，遇到疑惑或不懂的內容，與 AI 聊天機即時互動；
3. AI 實踐任務分學段互動：根據年級差異設計互動任務，一年級學生口述指令生成詩中圖片，三年級與 AI 對話解析詩歌內涵，五年級創作詩句。

4.3. 數據收集與分析

課後採用李克特量表收集數據，測量「情境沉浸感體驗」、「學習動機」及「學習效能」三大維度(共 12 題項)。此外，對實施教學的教師和學生進行半結構化訪談，教師焦點組(3 人)，探討技術整合優勢與挑戰，學生抽樣訪談(分能力強中弱的等級，各 3 人，共 9 人)聚焦體驗反思。

量化研究部分以實驗組與對照組進行比較，採用 Mann-Whitney U 檢驗及 Wilcoxon 符號秩檢驗(組間差異)比較實驗組與對照組在課堂趣味性、活動安排滿意度、延續學習意願等維度的差異。質性研究部分通過分析能力差異學生的學習體會訪談及教師訪談內容，驗證教案的有效性和適應性。

5. 研究發現

5.1. VR-AI 教學效果因應古詩文與年級組合呈現顯著差異

通過 Mann-Whitney U 檢驗，比較實驗組與對照組對學生學習興趣的影響，實驗組與對照組在學習興趣提升方面表現出不同效果。結果顯示，在三年級《九月九日憶山東兄弟》的教學中，實驗組於「課堂趣味性」($p < 0.001$)和「活動安排滿意度」($p = 0.002$)兩個維度均顯著優於對照組，且「課堂趣味性」的效應量 $r = 3.711/\sqrt{38} \approx 0.60$ 大於 0.5, $r = 0.60$ (大效應)。同時，五年級《江雪》的教學中，實驗組在「課堂趣味性」($p = 0.007$)、「活動安排滿意度」($p = 0.002$)也顯著優於對照組。表明三年級《九月九日憶山東兄弟》、五年級《江雪》的教學中，VR-AI 教學對學生的學習興趣有顯著提升。然而，在一年級《春曉》的教學中，實驗組與對照組在所有測量的學習興趣維度(如課堂趣味性、活動滿意度)中均未達到統計顯著差異($p > 0.05$)，一年級《春曉》的教學效果不明顯。

表 2. 學生學習興趣 Mann-Whitney U 檢驗結果分佈

古詩文	測量維度	統計量	P 值	效應量
九月九日憶山東兄弟(三年級)	課堂趣味性	Z = -3.711	0.000	0.60 (大效應)
	活動安排滿意度	Z = -3.101	0.002	0.50 (大效應)
	延續學習意願	Z = -3.242	0.001	0.53 (大效應)
江雪(五年級)	課堂趣味性	Z = -2.686	0.007	0.40 (中效應)
	活動安排滿意度	Z = -3.153	0.002	0.48 (中效應)
	延續學習意願	Z = -2.305	0.021	0.34 (小效應)
春曉(一年級)	課堂趣味性	Z = -1.024	0.306	0.14 (極小效應)
	活動安排滿意度	Z = -0.107	0.915	0.02 (無效應)
	延續學習意願	Z = -0.271	0.787	0.04 (無效應)

通過 Wilcoxon 符號秩檢驗對比同一批學生在「接受 VR-AI 教學前對比教學後」的學習興趣差異，結果顯示出明顯的組間差異，同時，VR-AI 古詩文教學介入效果呈現學段差異。整體表現為教學後，三年級學生在課堂趣味性($p = 0.001$)、活動安排滿意度($p = 0.015$)以及延續學習意願($p = 0.008$)這些維度的興趣「顯著提升」(p 值均 < 0.05)，效應量($r = 0.56$)顯示 VR-AI 教學對三年級學生的學習興趣提升強度高、影響顯著，表明技術介入對三年級學生學習體驗具有全面增強效應。相反，低年級(一年級)在學習《春曉》時，所有測量維度(如活動安排、延續意願、詩句記憶、情感理解)均未呈現統計學顯著差異(p 值遠 > 0.05)，效果量($r = 0.12$, 小效應)也極低，凸顯低年段認知特性可能削弱了技術介入的效果。在高年級(五年級)學習《江雪》的結果中， p 值均 > 0.05 ，統

計學上「無顯著差異」，說明教學後，學生興趣變化不明顯，且效果量 ($r=0.25$ ，小效應)，說明 VR-AI 教學對五年級學生的興趣提升幅度小，未達顯著水平。

表 3. 學生學習興趣 Wilcoxon 符號秩檢驗結果分佈

古詩文	課堂趣味性	活動安排滿意度	延續學習意願	整體學習興趣	效應量 (r)
九月九日憶山東兄弟 (三年級)	p=0.001	p=0.015	p=0.008	p=0.010	0.56 (大)
江雪 (五年級)	p=0.142	p=0.092	p=0.273	p=0.355	0.25 (小)
春曉 (一年級)	p=0.371	p=0.964	p=0.972	p=0.563	0.12 (小)

5.2. VR 場景可視化助能力弱學生彌補生活經驗的缺失

研究發現，VR-AI 古詩文教學對三年級《九月九日憶山東兄弟》等低複雜度、強場景古詩的學習興趣提升最顯著 (課堂趣味性 $r=0.60$ ，大效應)。這一發現在能力弱學生中體現為，通過 VR 還原詩中場景，直觀理解抽象詞彙。他們反饋「我可以透過畫面理解文字內容；可以看古代的真实情況，有臨場感」。教師觀察數據進一步佐證此效果，3 名教師指出學生透過視覺化來具體展示抽象詞彙能降低理解門檻。如某教師說：「透過這個 VR 的視覺展示，會比我強行要求同學記住要好。」補全能力弱學生因「生活經驗不足導致的理解缺口」。

5.3. 互動任務啟動中等能力學生的「參與-動機」鏈條

針對五年級《江雪》等需適度互動深理解的古詩，VR 即時問答與「找答案」小遊戲有效突破古今語言隔閡助，提升中等能力學生學習動機。他們對 VR-AI 的互動環節印象深刻，代表性陳述如「找答案的小遊戲，可以看到具體實物去猜答案。」3 名教師觀察總結出闖關式互動問答 (如「為看劇情積極答題」) 顯著提升參與度。這與研究中五年級《江雪》課堂趣味性 $p=0.007$ ，活動滿意度 $p=0.002$ ，實驗組顯著呼應，說明互動任務能突破「古今語言隔閡」，適配中等能力學生「需明確任務驅動」的學習特點。

5.4. 能力較強的學生則借助 VR 情景重構實現文化解碼與情感共鳴

對於能力較強學生，其核心聚焦在學習自主權。他們表示「我可以在 VR 世界選答案，並能多次嘗試」。3 名教師發現學生的學習模式轉為主動探索 VR 中的不同事物。他們皆認為「學生能主動探索及自主理解，顯著提升學生的參與度。」可見，學生由主動探索向自主理解轉變。

6. 結論與討論

本研究針對香港學生古詩文學習的兩大認知斷裂，即語言和文化，基於 Vygotsky 社會文化理論與 Barsalou 具身認知理論，建構「VR 場景沉浸結合 AI 互動鷹架」雙軌幹預模型。量化與質化共同驗證出 VR 感官具象化顯著降低抽象語言門檻 (如能力較弱的學生表示透過 VR 學習抽象詞彙能直觀接收)，尤其體現在彌合因古今造成的時空感知斷裂上，並呼應 Barsalou「感官體驗奠定抽象認知」的論說。同時，AI 的即時文化解碼有效解決 Gee (2014) 所指的「去情境化符號」挑戰，強化學生在 VR 中所見的影像，實現 Vygotsky 所提出的社會互動鷹架功能。此協同機制直接回應研究核心問題，即技術整合不僅實現文化符號的動態配合，也從分層設計彌合各學段差異。

研究發現進一步揭示技術效益的缺口：低年級 (一年級) 學生如同 Piaget 具體運思階段的認知局限，對《春曉》VR 教學無明顯效果 (效應量 $r=0.02-0.14$)，學生仍處於運思階段，即仍沒有對概念有所保留。能力強的學生則能自主探索實現文化的解碼，展現出「情境化互動」對情感內化的促成作用，亦為香港教育局「工具性與人文性並重」的政策目標提供實證路徑。

本研究發現，VR 和 AI 結合以功能性工具提升認知協同機制，從 VR 的多感官輸入補償生活經驗斷層，並直接具象化詩文中的時空背景以緩解時空感知斷裂。AI 則互動解析文化隱喻，二者共建「感官-文化-語言」整合鏈。另外，VR-AI 古詩文教學的學段特殊性，三年級學生在趣味性、滿意度、延續意願呈現正面效益 ($r=0.56$)，而一年級則需簡化技術的運用，五年級應強化文化深度。

7. 局限與未來方向

本研究透過混合方法驗證 VR-AI 教學對古詩文學習抽象語言的效能，在研究過程中，發現以下局限。樣本覆蓋不均衡，未來需擴充樣本量至小學各個年級，並嘗試加入不同文化背景學生，以強化統計推論。未來設計可依教師反饋分層優化，如低年

級加入動畫降低操作門檻。最後，長期動機維持機制尚未實證，量化結果中高年級「延續學習意願」的效應量偏低 ($r=0.34$) 及教師反饋指出新鮮感減退的應變方案，皆反映出一旦對技術新鮮感消退的風險。對此，可強化 AI 生成互動任務，從而延伸教學並透過動態內容更新與跨詩文的討論，深化文化共同性的情況作增潤而形成可持續性學習，從而達到香港教育局「從閱讀中學習」的核心目標。

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Strand

Quality Assurance in Higher Education and Training

高等教育與培訓的質素保證

Examining the Impact of Generative Artificial Intelligence Adoption Intensity on Work Engagement Based on the JD-R Theory

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ABSTRACT

In recent years, the rapid advancement of technology has accelerated the integration of artificial intelligence (AI) into various professional contexts, with generative AI (GenAI) becoming particularly prominent. The adoption of GenAI reshapes work processes and learning environments, creating both opportunities and challenges for employees as they adapt to new technological demands. Anchored in the Job Demands–Resources (JD-R) model, this study investigates two key mediating mechanisms—psychological empowerment and job insecurity—which represent personal resources and job demands within the framework. While GenAI has the potential to enhance individuals’ sense of meaning, competence, autonomy, and impact, thereby increasing motivation and engagement, its rapid implementation may also heighten job insecurity and reduce willingness to engage in work-related learning. Furthermore, perceived organizational support (POS) is incorporated as a key job resource. Within this construct, education training serves as a crucial signal of support—providing relevant GenAI-related training can mitigate employees’ negative perceptions, enhance their confidence in using new tools, and amplify positive effects. Approximately 300 valid responses will be collected, and statistical analyses will be conducted using SPSS and SmartPLS. Theoretically, this study contributes by addressing the research gap in GenAI adoption and extending the JD-R model with additional variables. And highlights the critical role of education training in enhancing organizational effectiveness during the adoption of new technologies. Practically, it offers organizations valuable insights for digital transformation and, through Importance–Performance Map Analysis (IPMA), helps prioritize improvement strategies in a cost-effective manner.

KEYWORDS

generative artificial intelligence, psychological empowerment, job insecurity, education training, work engagement

Futures in Arts Education: Perspectives from Pre-Service Music Teachers in the Philippines

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ABSTRACT

The current educational reforms in the Philippines push for a review of its teacher education programs (TEPs). As one of the TEPs that do not have its own Policies, Standards and Guidelines (PSGs) and Licensure Examination for Professional Teachers (LEPT), the Bachelor of Music in Music Education (BMMuEd) program faces challenges in quality assurance and professionalization. This study aims to probe on the perceptions about the future of culture and arts education as viewed by pre-service music teachers (PMTs) in the national university of the Philippines. The research probed on two main concerns: first, the vertical and horizontal alignment of the BMMuEd with the state-sanctioned allied programs Bachelor of Secondary Education in Music, Arts, Physical Education, and Health (BSMAPEH) and Bachelor of Culture and Arts Education (BCAEd); and second, perceptions of selected senior standing PMTs of how their current program prepares them for the profession. This research used an exploratory sequential mixed method design. Data was initially gathered from publicly available documents of the three programs and the professional requirements for licensed teachers, followed by the development of a Likert scale on the PMTs' perceptions on the alignment between their current program vis a vis the state-sanctioned allied programs and professional requirements for licensed teachers. Results of the study revealed that the BMMuEd bear a slight alignment with the state-sanctioned allied programs. While it offers edge in teaching musical skills and knowledge, the program needs to provide opportunities to include skills and content of allied components.

KEYWORDS

Culture and arts education, music teachers, quality assurance in tertiary education, pre-service teacher education, Philippines

Re-evaluating the Self-Directed Learning Scale: CFA Evidence for a Parsimonious Behavioural Measure in Vocational Education

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ABSTRACT

Self-directed learning (SDL) is essential for strengthening learner readiness in higher vocational education, yet most SDL scales were validated with university students. Whether these instruments retain structural validity and conceptual relevance for vocational learners remains largely untested. This study examined the factorial functioning of a widely used 10-item SDL scale and evaluated whether a shorter behavioural measure could provide a more suitable alternative. Using data from 462 vocational students, the original 10-item unidimensional model was tested through confirmatory factor analysis. Results did not support a single-factor structure, as indicated by Robust RMSEA = 0.152, CFI = 0.879, TLI = 0.845, SRMR = 0.063, and $\chi^2(35) = 199.732$, $p < .001$. These findings suggest item redundancy and multidimensional patterns that reduce the scale's structural coherence. A four-item behavioural model (Items 2, 3, 4, and 8)—selected for their strongest psychometric performance and direct reflection of core SDL behaviours—was subsequently tested. This model showed excellent fit [$\chi^2(2) = 0.948$, $p = .623$, RMSEA = 0.000, CFI = 1.000, TLI = 1.005, SRMR = 0.007]. The short form correlated strongly with the full scale ($r = .95$) and maintained solid external validity with academic self-concept (SDL-10: $r = .687$; SDL-4: $r = .632$). Overall, the findings indicate that the 10-item SDL scale appears not optimal for vocational learners, whereas a concise, behaviour-focused four-item measure offers a valid, efficient, and conceptually coherent alternative. This short form provides a practical tool for assessment, programme evaluation, and future interventions in vocational education.

KEYWORDS

Self-directed learning (SDL), vocational education. Confirmatory factor analysis (CFA), scale validation, short-form behavioural measure

Strand

Other Topics Related to Learning, Teaching and Assessment

其他與學習、教學和評估相關的主題

The Relationship Between Rural Junior Middle School Students' Belief in a Just World and Learning Engagement: A Moderated Mediation Model

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ABSTRACT

This study explored the predictive effect of belief in a just world (BJW) on learning engagement among rural junior middle school students and the mediating role of academic emotions, with class stratification as a moderator. A questionnaire survey was conducted on 431 students (Grades 7–9) in a rural middle school of Maoming, using the Just World Beliefs Scale, Adolescent Academic Emotions Questionnaire, and Learning Engagement Scale. After excluding invalid responses, 271 valid questionnaires were obtained (response rate: 62.88%), including 122 males and 149 females (Mean age = 14.45 ± 1.10). Results showed significant differences in BJW, academic emotions, and learning engagement between key and non-key classes. BJW positively predicted learning engagement, with both positive and negative academic emotions serving as partial mediators. Class stratification moderated the mediating path of negative academic emotions: negative emotions fully mediated the relationship in key class students, while no significant mediation was found in non-key class students. After controlling for gender and grade, the mediating effect of positive emotions (47.73%) was stronger than that of negative emotions (17.44%). The findings suggest that BJW acts as a psychological resource, emphasizing the need to address class stratification effects, maintain just-world beliefs, and promote positive academic emotions to enhance learning engagement.

KEYWORDS

belief in a just world, academic emotions, learning engagement, class stratification, rural junior middle school student

Enhancing Word Learning Through a Mental Imagery Strategy in L2 Classroom

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ABSTRACT

For several decades, educators have been searching for effective methods to improve instructional practices in L2 settings, particularly in teaching new vocabulary. Previous studies have shown that providing a sentence context or asking learners to translate sentences into the L2 can enhance vocabulary retention by integrating words into meaningful units. In contrast to these traditional techniques, the present study employs a new strategy — mental imagery. We investigate whether, compared to sentence translation alone, instructing learners to imagine a context and execute an action can be a more effective L2 vocabulary learning strategy. Forty-five French students enrolled in a Chinese as a Foreign Language course learned ten social and ten emotional abstract words: half through sentence translation and the other half through sentence translation while imagining a context associated with the L2 word. Memory performance was assessed through two translation tasks administered immediately after the encoding phase and again one week later. Results indicated that the imagery strategy produced better retention than the traditional translation approach, both in the short and long term. This aligns with the views of embodied cognition, suggesting that abstract concepts rely on the sensorimotor experience. We further discuss the effects of mental imagery on the acquisition of social and emotional abstract words in L2.

KEYWORDS

embodied cognition, mental imagery, sentence translation, foreign language learning, social and emotional abstract words

The Role of AI Literacy and Basic Psychological Needs in EFL Writing Self-Efficacy: A Structural Equation Modelling Study

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ABSTRACT

As Artificial Intelligence (AI) becomes increasingly integrated into the English as a Foreign Language (EFL) writing instruction, there is a growing need to understand the psychological mechanisms through which learners' AI literacy shapes their confidence and engagement in AI-assisted writing contexts. While previous studies have examined AI literacy and writing self-efficacy separately, the theoretical pathways connecting these constructs remain underexplored. Grounded in Self-Determination Theory (SDT), this study proposes a conceptual model in which AI literacy predicts EFL learners' writing self-efficacy both directly and indirectly through the satisfaction of two basic psychological needs: competence and autonomy. These needs are prioritized since AI-assisted writing tasks mainly involve personal cognitive efforts where the experience of skill enhancement and individual control is more prominent than the social connection. To evaluate the hypothesized pathways, 300 EFL university students will complete validated measures of AI literacy, basic psychological need satisfaction, and writing self-efficacy. Structural equation modelling will be employed to examine both direct and indirect relationships among the constructs. By articulating a theoretically grounded explanation of how AI literacy contributes to writing self-efficacy, this study aims to clarify the psychological processes underpinning learners' interactions with AI tools and provide insights for designing need-supportive AI-integrated writing instruction.

KEYWORDS

AI-assisted writing, AI literacy, basic psychological needs, writing self-efficacy, structural equation modelling

Screen Audio Description as a Writing Pedagogy: Practices in Hong Kong's University Chinese Classrooms

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ABSTRACT

University-level Chinese writing instruction in Hong Kong perennially grapples with students' tendency to “tell rather than show”—a challenge rooted in cursory observation and imprecise description. This study aims to investigate the efficacy of integrating screen audio description (AD) as an innovative pedagogy for cultivating precise descriptive skills. The pedagogical rationale is that AD inherently requires students to translate complex visual information into precise, evocative language, thereby honing their observational and expressive abilities. Employing a mixed-methods case study design, the research will implement a pedagogical intervention for approximately 50 undergraduates. The curriculum is structured to guide students through analysing film clips with and without AD, critically evaluating professional scripts, and engaging in the hands-on practice of composing their own AD for silent media. To assess the intervention's effects, the study will collect descriptive writing samples (pre- and post-test), supplemented by classroom observations and post-activity questionnaires. The analysis will address two key areas. First, a comparative review of pre- and post-test writing samples will assess measurable changes in students' capacity to articulate visual detail and employ nuanced language. Second, questionnaire data will be used to explore students' self-perceived development in descriptive confidence, media literacy, and inclusive awareness. Ultimately, this study seeks to determine whether an AD-based pedagogy can provide a theoretically sound and practically effective framework for enhancing contemporary writing instruction and to evaluate its potential for broader application within Chinese language education.

KEYWORDS

Feedback ecological model, external feedback, feedback orientation, feedback processing, second language writing education

Mapping the Conceptual Landscape of Student Feedback Literacy: A Macro–Meso–Micro Analysis toward AI-Generated Feedback Engagement

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Abstract: *Student feedback literacy (SFL), which refers to students' abilities to understand, interpret, and use feedback, is increasingly recognized as a critical enabler of effective feedback uptake and performance improvement. Over the past decade, several conceptual frameworks have emerged to capture the multifaceted nature of SFL. However, the growing influence of Generative AI (GenAI) in feedback processes has challenged existing feedback literacy constructs. This mapping review synthesizes ten conceptual papers on SFL, identified through systematic searches in Web of Science and Scopus between 2018 and 2025. The selected studies were analyzed to understand how SFL is conceptualized and operationalized across macro (policy/systemic), meso (institutional/pedagogical), and micro (individual/student) levels, and how this can inform the concept of student GenAI-mediated feedback literacy. The review shows a clear shift in how student feedback literacy is understood—from viewing feedback as information delivery to seeing it as a social, cultural, and contextual practice. Most studies speak to the micro level, emphasizing learners' judgement, emotions, and actions when working with feedback. At the meso level, the focus is on how teachers, peers, task design, and classroom routines shape students' opportunities to engage with feedback. Macro-level discussions are fewer, but they highlight how curriculum structures, institutional norms, and broader technological and sociocultural conditions frame feedback practices. Taken together, these findings suggest that feedback literacy in the GenAI era is best seen as an ecological process operating across interconnected macro, meso, and micro layers. This ecological perspective helps explain how students make sense of, question, and use GenAI-generated feedback within the conditions provided by their courses, teachers, and wider learning environment.*

Keywords: *student feedback literacy, engagement, GenAI-generated, conceptual, ecological perspective*

1. Introduction

Feedback is widely recognized as the cornerstone of formative assessment in the classroom, significantly influencing student learning and performance (Carless, 2022; Molloy et al., 2020). Student feedback literacy (SFL), which refers to students' abilities to understand, interpret, and use feedback, is increasingly recognized as a critical enabler of effective feedback uptake and performance improvement (Carless & Boud, 2018; Sutton, 2012). Sutton (2012) conceptualizes feedback literacy through three dimensions: knowing (understanding how and what can be learned through feedback), being (developing learner identity, self-confidence, and affective regulation), and acting (cultivating the ability to read, interpret, and apply feedback). Similarly, Carless and Boud (2018) emphasize the importance of proactive engagement, continuous adjustment, and emotional management as key components that enable students to take meaningful action on feedback and enhance their learning performance. However, these perspectives on SFL largely frame engagement as an individual capacity, overlooking how broader learning environments, social interactions, and institutional structures critically shape the development and enactment of feedback literacy.

In recent years, the emergence of generative Artificial Intelligence (GenAI) has reshaped the feedback practice (Huesca et al., 2025), as GenAI tools such as ChatGPT and Gemini have been recognized as promising feedback providers (Ba et al., 2025; Teng, 2024). Unlike static digital tools, GenAI systems can interact dynamically with users, generating feedback in response to prompts through mechanisms such as deep learning, machine learning, and natural language processing (Huesca et al., 2025). This interactivity enables GenAI tools to provide students with real-time, adaptive feedback that encourages them to engage continuously with their learning (Ba et al., 2025; Escalante, Pack, & Barrett, 2023; Henderson et al., 2025). However, the growing influence of GenAI in feedback processes has challenged existing constructs of student feedback literacy. Engaging with GenAI requires new forms of understanding, abilities, and dispositions that differ from those traditionally associated with teacher or peer feedback (Zhan et al., 2025). In this AI-mediated era, SFL should therefore be understood not as a fixed individual ability, but as shaped by multiple interrelated factors of the learning environment.

Given the fragmented and emerging nature of SFL, particularly in response to the rapid growth of GenAI over the past few years, this mapping review aims to chart the conceptual landscape of SFL in the current literature. A mapping approach is particularly well-suited for identifying how the conceptual frameworks of SFL have evolved, where theoretical gaps remain, and how these constructs might be reconceptualized to address the unique affordances and constraints of GenAI feedback. To provide coherence to this synthesis, the review adopts Bronfenbrenner's (1979) ecological model, which emphasizes multi-layered levels of influence on human development. By situating SFL within this ecological framing, the review demonstrates how feedback literacy emerges from the interplay of structural, pedagogical, and personal factors, offering a more holistic and

contextually grounded understanding of SFL and informing how feedback engagement should be promoted in GenAI-mediated instruction.

2. Methods

2.1. Searching, Screening, and Selecting Relevant Papers

A targeted literature search, guided by the PRISMAS framework, was conducted in two databases, including Web of Science and Scopus, using the search string TITLE ("feedback literac*") AND (student* OR learner*), focusing on publications from 2018 to 2025 to capture developments following Carless and Boud’s (2018) work on SFL. The search, performed in November 2025, initially yielded 201 records (101 from Scopus and 100 from WoS), which were reduced to 102 after removing 99 duplicates. Of these, 89 were excluded because they were not conceptual or theoretical papers, leaving 13 for full-text screening. Three additional articles were excluded due to their involvement in empirical data collection, resulting in a final set of 10 conceptual or theoretical articles on student/learner feedback literacy for the data extraction and coding process.

2.2. Data Analytical Framework

The selected conceptual papers were coded and analyzed using the Macro–Meso–Micro model, originally proposed by Bronfenbrenner (1979), to adopt an ecological approach to examining human development. This model offers a multi-layered analytical framework for examining SFL within nested levels of influence, ranging from systemic structures to individual learner experiences. Specifically, the Macro level focuses on the broader educational and technological context, such as institutional policies, feedback culture, and digital integration. The Meso level examines pedagogical, social, and design mechanisms, including teacher–student, peer, activity design, and curriculum design. The Micro level explores individual learner processes and differences in response to feedback.

3. Findings

To synthesize the conceptual landscape of student feedback literacy (SFL), Table 1 presents a tentative mapping of key themes across three ecological levels—macro, meso, and micro (an extended summary of the included papers is provided in Table 2 in the Appendix). This categorization emerged inductively from the analysis of ten selected conceptual papers and reflects the multi-layered nature of SFL as shaped by broader sociocultural contexts, pedagogical practices, and individual learner dispositions. The ecological framework provides a coherent structure for organizing these themes and highlights the interdependent factors influencing feedback literacy development.

Table 1. Ecological levels and coded SFL themes

Ecological Level	Coded SFL themes (tentative mapping)	References
Macro Level (Systemic & Structural Conditions)	Institutional feedback policies and assessment regulations	Carless & Boud (2018)
	Social-cultural contexts	Carless (2020)
	Feedback environment	Chong (2020)
	Technology affordances	Spooner & Pawlikowska (2023)
		Tripodi et al. (2020)
	Wongvorachan et al. (2022)	
	Yu & Liu (2021)	
Meso Level (Pedagogical, Social, & Design Mechanisms)	Teacher scaffolding	Carless & Boud (2018)
	Peer collaboration	Carless (2022)
	Teacher–student relationship	Chong (2020)
	Activity design (self-assessment, peer feedback, exemplars, & reflection)	de Kleijn (2023)
	Curriculum design	Little et al. (2020)
	Malecka et al. (2020)	
	Spooner & Pawlikowska (2023)	
	Tripodi et al. (2020)	
	Yu and Liu (2021)	

Micro Level (Individual Processes & Dispositions)	Students' engagement	Carless (2020)
	Students' self-regulation	Chong (2020)
	Students' agency	David & Boud (2018)
	Students' individual differences	Spooner & Pawlikowska (2023)
	Students' previous experiences	Tripodi et al. (2020)
	Students' beliefs	Wongvorachan et al. (2022)

4. Discussions and implications

The mapping review reveals that SFL can be operationalized across three ecological levels of the learning environment. At the macro level, SFL is embedded within systemic and contextual conditions that shape how students perceive and act upon feedback. Sociocultural perspectives emphasize the impact of cultural norms and institutional environments on students' receptivity to feedback (Chong, 2020; Spooner & Pawlikowska, 2023). Therefore, creating psychologically safe spaces is critical for students' engagement with feedback (Tripodi et al., 2020). Moreover, technological affordances such as LMSs, forums, and online platforms can expand opportunities for interactive and accessible feedback (Carless, 2020; Yu & Liu, 2021; Wongvorachan et al., 2022). Despite a limited discussion in the existing literature of SFL, the macro level highlights that SFL relies on supportive environments and infrastructures that legitimize and facilitate feedback practices. At the meso level, SFL develops through pedagogical mediation and social interaction. Teachers play a central role in scaffolding students' capacity to interpret and act on feedback through coaching, guiding, and modelling (Carless & Boud, 2018; de Kleijn, 2023; Carless, 2022). Teacher feedback literacy itself is also an enabling condition that can foster SFL (Carless, 2020; Chong, 2020). Peer collaboration further enhance feedback processes by fostering students' evaluative judgment and confidence through peer assessment and peer review activities (Tripodi et al., 2020; Yu & Liu, 2021). Additionally, classroom activity design, including the use of exemplars, rubrics, reflection, and dialogical processes, can provide structured opportunities for students to practice using and providing feedback, thereby promoting their feedback capabilities (Chong, 2020; Yu & Liu, 2021). More importantly, embedding feedback practice as a core part of the curriculum is believed to ensure a more sustained feedback literacy across programs (Malecka et al., 2020). At the micro level, SFL is most frequently enacted through individual engagement, agency, and dispositions. Feedback engagement spans cognitive, affective, and behavioral dimensions (David & Boud, 2018; Chong, 2020), with self-regulation sustaining meaningful interaction (Wongvorachan et al., 2022). Student agency involves their responsibility and active participation in feedback processes (Tripodi et al., 2020; Little et al., 2024; Yu & Liu, 2021). It is also demonstrated that students' prior experiences, beliefs, and personal abilities can impact how feedback is received and applied (Chong, 2020; Spooner & Pawlikowska, 2023). The micro level emphasizes that SFL is not uniform but mediated by individual differences and dispositions that condition how feedback is understood and acted upon.

These insights into the current conceptual landscape of SFL can also provide meaningful guidance on how to foster students' engagement with GenAI feedback. At the macro level, SFL in GenAI-mediated instruction is shaped by broader systemic and structural conditions, including institutional feedback and AI policies, socio-cultural contexts, and AI affordances. Policies and assessment frameworks determine whether AI-generated feedback is legitimized and embedded into learning, while cultural attitudes toward technology and autonomy influence students' trust and willingness to engage with GenAI. At the same time, the design and accessibility of GenAI tools can expand opportunities for personalized, immediate feedback, but also require students to understand their limitations. Thus, feedback literacy at this level involves recognizing the wider environment in which GenAI operates and situating AI feedback within legitimate, ethical, and systemic learning practices. At the meso level, classrooms and learning communities can mediate how students engage with GenAI feedback through teacher scaffolding, peer collaboration, curriculum design, and structured activities. Teachers play a critical role in guiding students to prompt effectively, evaluate AI responses, and integrate them meaningfully into learning tasks, while peers provide opportunities to compare and critique AI-generated feedback alongside human perspectives. Curriculum design determines whether GenAI feedback is embedded into iterative, reflective learning processes or used superficially. Feedback literacy here is co-constructed through pedagogical practices and social interactions, enabling students to learn how to use GenAI feedback critically, collaboratively, and responsibly. At the micro level, student feedback literacy can be enacted through individual engagement, experiences, and AI literacy. Students' prior experiences with feedback and self-regulated learning can shape how they interpret and act on GenAI feedback, and their dispositions influence whether they use AI feedback as a tool for empowerment or dependency.

5. Limitations and future directions

Given the rapid development of AI feedback systems, the ecological themes of SFL identified in this review should be regarded as provisional rather than definitive. While the macro-meso-micro synthesis provides a useful lens for conceptualizing student feedback literacy (SFL), emerging frameworks in AI-enabled learning (e.g., Ba et al., 2025) point to additional mechanisms, such as algorithmic decision processes, model architectures, and learner-AI interaction patterns, that extend beyond traditional teacher or peer feedback. The absence of GenAI-focused studies in the current conceptual literature

underscores the need for iterative refinement of these themes through ongoing coding, comparative analysis across frameworks, and empirical investigation. Future research should therefore aim to integrate socio-technical dimensions into ecological models of SFL, ensuring that conceptualizations remain responsive to evolving feedback practices in the AI era.

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Appendix

Table 2. Extended summary of included conceptual papers

No.	Studies	Operationalization of SFL at three levels		
		Macro Level	Meso Level	Micro Level
1	de Kleijn (2023)	N/A	Teacher scaffolding Peer scaffolding	Student strategies to seek feedback and provide diagnostic information Using internal feedback
2	Carless & Boud (2018)	N/A	Peer feedback & exemplars Teacher roles through curriculum design, guidance, coaching, and modelling. Assessment design	Student responses to feedback by appreciating, making judgments, managing affect, and taking action Students' previous experiences and characteristics

3	Tripodi et al. (2020)	A safe learning environment for feedback practice	Make feedback curricula focus Utilize exemplars and peer feedback Use technology to augment the feedback process Evaluate and refine the feedback process	Learners' active role in the feedback process
4	Little et al. (2024)	N/A	Activities design Feedback judgment activities	Student's responsibility, confidence and agency in the feedback process
5	Malecka et al. (2020)	N/A	Embed feedback in the curriculum	Students' engagement with feedback
6	Spooner & Pawlikowska (2023)	Feedback environment as a modifiable factor Feedback as a social-cultural event	Teacher roles Teacher-learner relationship	Students' valence and personal beliefs
7	Yu & Liu (2021)	Educational technology and assessment knowledge Feedback as learner-centred dialogue	Teacher- and peer-scaffolding Activities to enhance students' feedback literacy	Students' emotions, agency, and self-regulation in feedback use
8	Carless (2020)	Feedback shifts from information to process Digital affordances	Peer review & exemplars as proxies for teacher feedback Teacher feedback literacy as an enabler	Learner agency Internal feedback
9	Chong (2020)	Cultural influence on students' perceptions and uptake of feedback	Textual level Interpersonal level Instructional level	Cognitive, affective, and behavioral engagement Individual beliefs and goals, feedback experience, and abilities
10	Wongvorachan et al. (2022)	Technology affordances and e-learning	Learning analytics-based feedback	Feedback beliefs & experiences Engagement & self-regulation

Note: N/A = not applicable

Feedback Orientation, Self-Directed Learning, and Academic Self-Beliefs among Vocational Students: Cross-Sectional Evidence from an SDT Perspective

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ABSTRACT

Research on vocational learners has largely emphasised skills training and employment outcomes, leaving limited understanding of the psychological factors that shape their everyday learning. Feedback orientation (FO), self-directed learning (SDL), and academic self-concept (ASC) are central to how students engage with instruction, yet their interrelationships in vocational settings remain underexamined. This study addressed this gap by analysing how FO relates to SDL and two components of ASC. Drawing on Self-Determination Theory, FO was conceptualised as a set of motivational orientations potentially associated with autonomous learning behaviours and students' self-beliefs. FO dimensions were strongly interrelated ($r_s = .714-.839$) and showed moderate correlations with SDL ($r_s = .429-.531$) and ASC ($r_s = .346-.441$). Structural equation modelling indicated that FO was positively related to SDL, while SDL was positively associated with both ASC-competence and ASC-affect. Direct paths from FO to ASC were weak, with significant indirect associations emerging through SDL. These findings align with an SDT view in which internalised orientations toward feedback relate to how learners regulate their learning, which in turn corresponds with their academic self-beliefs. Theoretically, the results highlight SDL as a more proximal correlate of ASC than FO, underscoring the value of distinguishing motivational dispositions from enacted learning behaviours. Practically, the patterns suggest that helping vocational students interpret and use feedback productively, alongside strengthening their self-regulatory strategies, may support their academic self-perceptions. Given the high coherence among FO dimensions, bi-factor analyses may further clarify how general and specific aspects of FO relate to SDL and ASC.

KEYWORDS

Feedback orientation; self-directed learning; academic self-concept; vocational education; Self-Determination Theory

Reinterpreting Feedback Literacy Interventions through Attribution Theory: A Mechanism-Based Analysis of Student Causal Beliefs

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ABSTRACT

Recent work has synthesised emerging evidence on interventions designed to improve students' feedback literacy (SFL). A widely cited scoping review by Little, Dawson, Boud and Tai (2024) summarised 16 studies screened from 445 records and reported consistent gains in students' confidence, evaluative judgement, role understanding, and appreciation of feedback processes, alongside limited evidence of behavioural change and insufficient attention to emotional dynamics. To extend theoretical insight into these patterns, this study reinterprets the 16 interventions using attribution theory, focusing on students' causal beliefs about performance, improvement, and feedback engagement. Attribution theory provides a coherent explanatory mechanism for understanding how intervention activities (e.g., peer assessment, exemplar analysis, reflective journals) implicitly reshape learners' interpretations of success and difficulty. Our remapping indicates that improvements observed in the scoping review align with shifts toward internal, unstable, and controllable attributions. Students increasingly viewed feedback improvement as strategy-based rather than ability-based, which supports the documented increases in confidence, agency, and evaluative judgement. Conversely, persistent gaps in behavioural enactment and emotional regulation correspond to areas where causal beliefs may be mixed or insufficiently addressed. Few interventions directly addressed attributional reframing, and emotional processes, central to the attribution–affect pathway. Taken together, integrating attribution theory with current evidence on SFL interventions offers an additional transparent account of why some aspects of feedback literacy progress more readily than others. The analysis highlights contextual and pedagogical factors that may foster adaptive causal beliefs and identifies opportunities for future interventions to address attributional and emotional aspects of feedback more directly.

KEYWORDS

Feedback literacy, feedback interventions, attribution theory, causal beliefs

Enhancing Ethics Education Differently: A Pilot Study on the SECI Model in Practice

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ABSTRACT

Ethics learning involves the development of ethical reasoning, critical reflection, attitudinal and behavioural change. To encourage students to articulate and exchange ethical perspectives, the research team applied elements of Nonaka's SECI model (Socialisation, Externalisation, Combination, Internalisation) in the design of two ethics seminars. In the socialisation mode, speakers and students engaged in open discussions that facilitated the sharing of personal experiences and ethical viewpoints. Through externalisation, they articulated their thoughts and insights, contributing to a shared understanding of complex ethical issues. In the combination mode, students integrated newly acquired knowledge with their existing understanding, thereby enhancing cognitive synthesis. Finally, in the internalisation mode, students demonstrated attitudinal changes in applying the acquired knowledge to real-life contexts. In 2022 and 2023, two rounds of ethics seminars were conducted at a tertiary education institution in hybrid mode. Seminars began with invited speakers presenting real-life ethical scenarios, such as helping others in public spaces and navigating different roles in team-based projects. The facilitator then invited students to share their perspectives on those ethical dilemmas by using technology-enabled response systems and in-depth discussions. At the end of the seminars, students were asked to complete a questionnaire, based on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree) and open-ended question, to evaluate their self-perceived learning impact through the lens of the SECI model. A total of 13 and 11 responses were collected from the ethics seminars conducted in 2022 and 2023, respectively. The results indicated overall positive perceptions, with average scores exceeding 4.0 across all four SECI modes in both years, except for the socialisation mode in 2022, which received a slightly lower average score of 3.6. Based on the responses to the open-ended question, some participants suggested more discussion in face-to-face mode. These pilot findings suggest that the ethics seminars were effective in supporting knowledge co-creation, particularly by fostering collaborative opportunities for reflection, integration, and practical application.

KEYWORDS

ethics, education, SECI Model

Reimagining Assessment Literacy through Ecological Linguaging Competencies (ELC)-Oriented Assessment

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ABSTRACT

Informed by the "linguaging" lens of the Distributed Language View (Thibault, 2011, 2021a/b; Thibault & Lin, 2025; Thibault, Lin & Liu, forthcoming), an emerging paradigm in language assessment conceptualizes the goal of language learning as the development of Ecological Linguaging Competencies (ELCs) (The New Territories Group, forthcoming). This framework theorizes language learning as a dynamic, holistic process of ecological sense-making, entailing cultural enskillment and the development of agency to integrate social actors, symbolic resources, and material artifacts across physical and digitally-mediated settings. However, the negative washback effect of high-stakes, traditional oral assessments creates an artificial testing environment that can trigger a fight-or-flight response, heightening anxiety and self-doubt. Consequently, they often fail to capture the authentic nature of real-world communicative tasks or gauge students' genuine competencies. This study empirically investigates an ELC-guided assessment framework to address these limitations. Using a mixed-methods approach in a multilingual ELT classroom, the research team co-developed ELC-based speaking tasks and descriptors to enhance the ecological validity of the assessment tasks. Students' speaking performances (N=22) were cross-checked by a native English teacher (NET), a local teacher and two researchers. Surveys and focus group interviews explored students' learning and teachers' experiences. Findings indicate that ecologically valid assessments boost confidence and reduce anxiety level. They stimulate a cognitively and emotionally positive environment where students can show their true communicative abilities. This implies that ELC serves as a teacher-actionable framework for designing more valid and humanizing language assessments.

KEYWORDS

ELC, ecology, linguaging, assessment, washback effect

Enhancing Student Feedback Literacy Development Through Online Interactive Peer Assessment

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ABSTRACT

Student feedback literacy has been recently regarded as a crucial condition for deciding the power of feedback over learning. It has also been highlighted as a core one of graduate attributes that supports students' future careers and life-long learning. However, the cultivation of student feedback literacy is a challenging task for university teachers. This project aimed to develop student feedback literacy via online interactive peer assessment in three educational courses. The '4 R' stages of OIPA (i.e., Requesting peer feedback; reviewing peers' work; responding to peer feedback; and revising work based on peer feedback) were designed and implemented in three cycles. This quasi-experiment involved 114 students in three experimental class groups and 104 students in three control class groups. A pre-and-post survey on feedback literacy was collected to discern whether online interactive peer assessment impacted the development of student feedback literacy. Post-survey interviews with the participants from the experiment groups (n=31) were used to triangulate the survey data and explore the reasons underlying the possible change in feedback literacy. The results showed that compared with the control groups, the experimental groups increased their feedback literacy more significantly, especially regarding appreciation of feedback and readiness to engage. Dialogic feedback embedded in online peer assessment was crucial in promoting student feedback literacy.

KEYWORDS

feedback literacy, online interactive peer assessment, dialogic feedback, higher education

Developing and Validating a Scale for STEM Self-Efficacy Among Chinese

Adolescents: A Focus on Gender Differences

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Abstract: *With the rapid development of STEM education, an increasing number of primary and middle school students in Mainland China are being introduced to foundational STEM courses. However, there remains a lack of well-established and systematically designed assessment tools to measure STEM-related self-efficacy among younger learners, especially in the early phases of STEM educational implementation. In response to this gap, this study has developed an instrument to assess STEM self-efficacy specifically for primary and middle school students in Mainland China. This instrument is intended to capture students' self-perception and drive at the beginning stages of their STEM learning experience. A total of 614 students from Mainland China participated in this study. Through a process involving initial item selection, teacher-student interviews, and a pilot test, the formal questionnaire was designed and developed. The results of the confirmatory factor analysis (CFA) indicated that the instrument is suitable for younger students in Mainland China. Furthermore, independent sample t-tests revealed no significant gender differences. Additionally, we provide insights for future research based on these findings.*

Keywords: STEM self-efficacy, instrument development, STEM education, gender difference

1. Introduction

STEM (Science, Technology, Engineering, and Mathematics) education originated in the United States in the 1990s, promoting 21st-century skills such as adaptability, creativity, and critical thinking (Bybee, 2010). Over the past several decades, STEM education has gained significant global attention, with many countries implementing policies to enhance teenagers' skills for international development (English, 2016). China has prioritized educational development, particularly through the 2016 '13th Five-Year Plan for Educational Informatization,' which called for an interdisciplinary teaching model in K-12 education. Initiatives like the National Institute of Educational Sciences (NIES) and the 'STEM Education Alliance of Guangdong-Hong Kong-Macao Greater Bay Area' have further advanced STEM research and practice. In 2023, the establishment of the International Institute for STEM Education in Shanghai marked a significant step toward integrating STEM education internationally.

Despite rapid advancements, effective instruments for evaluating STEM implementation remain limited. Students' self-efficacy are critical for learning effectiveness, yet most existing scales are derived from Western contexts and may not apply to Chinese primary STEM learners (Dong et al., 2020). Current instruments often focus on high school and college students, neglecting younger age groups where STEM education is primarily initiated (Zhang & Zhou, 2023). Since systematic STEM curricula are still developing in most regions, this study aims to develop a scale to measure STEM self-efficacy for lower-grade students in Mainland China, specifically designed to target STEM courses and their unique characteristics. We also investigated gender differences in STEM self-efficacy.

2. Literature Review

2.1. Self-efficacy in STEM Education

Self-efficacy, a central tenet of Bandura's social cognitive theory, refers to an individual's judgment of their capabilities to organize and execute courses of action required to achieve specific goals or performances. In academic settings, it profoundly influences the effort and persistence students devote to learning and is a critical predictor of academic achievement and resilience (Aharony & Gazit, 2019; Cassidy, 2015). Students with high self-efficacy are more likely to employ deep-learning strategies and persevere through challenges.

In STEM education, self-efficacy measures students' confidence in their ability to successfully complete STEM-related tasks. According to social cognitive theory, self-efficacy is not a fixed trait but can develop as students acquire skills, particularly in new learning areas like introductory STEM courses (Usher & Pajares, 2008). However, the lack of instruments measuring self-efficacy among younger students in the early stages of STEM implementation in Mainland China is notable. Given the distinct pedagogical and cultural context of Chinese STEM education—which may differ from Western models in its emphasis on inquiry-based learning—developing a tailored scale is essential for accurate assessment and effective instructional support (Bartimote-Aufflick et al., 2016).

2.2. Gender Difference in STEM Education

Research on gender disparities in STEM self-efficacy has yielded inconsistent findings. While some studies, often aligned with persistent stereotypes, suggest that male students tend to exhibit higher confidence in STEM-related domains (e.g., Wan, 2021), other empirical investigations—including those conducted in specific cultural settings such as China—report no statistically significant gender differences in these psychological constructs (e.g., Wang & Berlin, 2010). The perception of a gender gap is frequently explained by contextual and social factors, including differential socialization patterns, exposure to stereotype threat, and limited visibility of female role models in certain scientific fields.

These contradictory results raise critical questions about whether observed variations reflect inherent gender traits or are influenced by methodological limitations, such as variations in research instruments, sample characteristics, or cultural context. Understanding the roots of these discrepancies is not merely an academic concern; it carries significant implications for the development of gender-inclusive instructional strategies and the promotion of equity in STEM education (Kiran & Sungur, 2012). Therefore, to contribute to this ongoing scholarly discussion, the present study aims to examine gender differences in STEM self-efficacy among younger students in Mainland China, with a specific focus on the initial stage of their formal STEM learning experience.

3. Research Questions

1. Is the self-efficacy scale developed in this study suitable for measuring the STEM self-efficacy among lower-grade students in mainland China?
2. Do gender factors influence the STEM self-efficacy of students in mainland China?

4. Research Method

4.1. Sample

The formal sample was collected from four public schools in northern Mainland China. Participants ranged from 11 to 15 years old ($M=12.59$, $SD=1.13$), spanning grades 5 (primary) to 3 (middle school). After obtaining informed consent, paper-based questionnaires were administered in class. A total of 614 valid questionnaires were analyzed (316 from primary school, 298 from middle school), after removing responses with missing values.

4.2. Instrumentation

For instrument development, we considered three aspects: the features of the STEM curriculum, the content of the STEM curriculum in Mainland China, and the beginning stages of STEM in Mainland China. In designing the questions, we referred to the STEM learning theory framework (So et al., 2018) and the Chinese STEM self-efficacy questions (Luo et al., 2021). The questions were designed to holistically assess students' STEM self-efficacy in performing STEM-related tasks. Moreover, we considered the educational background and language habits of primary and middle school students in Mainland China. We also designed different versions of the questionnaire for different age groups.

4.3. Data Analysis

After collecting the data from the sample, the kurtosis and skewness of the individual questions were measured to ensure the normality of the data. Then, the reliability of the questionnaire was tested. Kaiser-Meyer-Olkin (KMO) and Bartlett's Test were used to measure the instrument's structural validity and confirm that the data fulfilled the conditions for factor analysis. The individual questions of the instrument were adapted from the developed scale, and the individual questions had good internal structural validity in the original version of the scale. Therefore, in this study, only structural equation modeling (SEM) was used for CFA to provide more robust evidence of structural validity. After verifying the validity of the instrument, we used SPSS 28.0 to discuss research question two. Gender differences in STEM self-efficacy among primary and middle school students were explored using the independent sample t-test with gender as the grouping variable.

5. Results

5.1. Reliability analysis

Reliability analysis demonstrated strong internal consistency for the Self-efficacy Scale across both sample groups. As shown in Table 1, Cronbach's Alpha for the self-efficacy items was 0.872 for primary school students and 0.885 for middle school students. The values of Cronbach's Alpha were all greater than 0.8, which prove that the instrument has a good internal consistency.

Table 1. Reliability of the instruments.

Groups	Items	Cronbach's Alpha for each item	Cronbach's Alpha for Overall Scale
Primary school	Self-efficacy	9	0.872
Middle school	Self-efficacy	9	0.891

5.2. Confirmatory Factor Analysis

Based on the results of the analyses mentioned earlier, both groups (primary school and middle school) data were suitable for factor analysis. The CFA was conducted using AMOS28, and a comparison of the results obtained with the goodness-of-fit index showed that the data fit the model well (The fit indices of the CFA results are shown in Table 2).

Table 2. Fit indices of the SEM measurement (CFA) models of the instruments.

Groups	Items	CMIN	DF	CMIN/DF	RMR	RMSEA	GFI	CFI	NFI	
Primary School	Self-efficacy	9	147.812	82	1.803	.047	.050	.945	.975	.947
Middle School	Self-efficacy	9	118.424	71	1.668	.034	.047	.947	.971	.932

5.3. Gender Difference

Since the sample data obeyed the normal distribution and the samples were independent of each other, we used the independent samples t-tests to explore the gender difference of two groups. The results were obtained (Table 3&4), and all p-values are greater than 0.05. Therefore, there is no gender difference in STEM self-efficacy in both primary and middle school samples.

Table 3. Results of Independent Samples t-test for Primary School.

Items	Gender	N	Mean	Std. Deviation	t	sig.
Self-efficacy	1	157	32.36	8.425	1.236	0.217
	2	159	31.19	8.278		

Table 4. Results of Independent Samples t-test for Middle School.

Items	Gender	N	Mean	Std. Deviation	t	sig.
Self-efficacy	1	136	30.51	5.782	0.828	0.409
	2	162	29.96	5.668		

6. Conclusion and Discussion

6.1. Instrument Development

The scale developed in this study serves as a useful tool for examining the STEM self-efficacy of students in Mainland China during the initial phase of STEM learning. It also offers a means to assess the effectiveness of STEM programs or related activities. With a moderate number of items, the scale helps ensure response quality and improves assessment efficiency. Although originally designed for younger students in Mainland China, the instrument is expected to be highly applicable to students in other regions where STEM education is still in its early stages—a point that can be further examined in future applications. Moreover, the scale can be used to explore students' STEM self-efficacy in relation to factors such as family educational background, school environment, or targeted intervention activities.

6.2. Gender Difference

The findings of this study reveal no significant gender differences in STEM self-efficacy among elementary and middle school students in mainland China. This result aligns with and extends a growing body of recent research that challenges traditional assumptions of male advantage in STEM. Contrary to longstanding stereotypes, our data indicate that boys and girls in the sampled age group exhibit comparable levels of confidence when engaging with science and STEM-related subjects. The absence of observable gender divergence invites a critical re-examination of the socio-educational mechanisms at play. Historically, gender differences in STEM have been a central subject of academic inquiry, often framed not only as a matter of disparity but also as a critical issue of educational equity (Forgasz & Rivera, 2012). The present findings suggest that with progressive reforms and a conscious shift toward more equitable educational practices, the previously documented performance and confidence gaps are not inevitable. The progressive narrowing of historical gender gaps lends support to the

view that there may be no inherent, biological determinants predisposing one gender to be more adept or motivated in science. Instead, these patterns highlight the powerful role of a changing educational environment.

Consequently, these results carry significant implications for instructional design. They underscore the importance of moving beyond gender-based assumptions and focusing on creating genuinely inclusive learning ecosystems. Educational efforts should prioritize fostering gender equality by providing supportive platforms, diverse role models, and equitable encouragement—with particular attention to sustaining girls' engagement. While the early indicators are promising, the long-term trajectory of female participation in STEM fields remains a critical area for future longitudinal research. Continued monitoring is essential to ensure that this early parity translates into sustained involvement and advancement in STEM careers.

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Why Do Higher Education Students Not Use GenAI for Academic Purposes?

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Abstract: *Generative AI (GenAI) has rapidly entered higher education, yet some students refrain from using it for academic purposes. This study explores reasons for non-use, through a bottom-up qualitative analysis of students' responses to a single open-ended survey item in a large multidisciplinary university in Israel. Five themes emerged: Incompetency (lack of knowledge or skills), Ineffectiveness (poor fit to academic needs), Ethics (concerns over legitimacy and fairness), Mistrust (unreliable outputs), and Harm (negative impact on learning). The findings highlight considerations that are under-represented in traditional technology adoption models. We discuss how these themes can inform task-centered GenAI literacy initiatives and the development of context-sensitive institutional guidelines.*

Keywords: generative artificial intelligence, higher education, students, non-use

1. Introduction

In educational context, digital artifacts must be adopted by humans to have an impact on various stakeholders, be it learners, teachers, policymakers, parents, etc. Over the last few decades, therefore, along with vast research on the impact of technology in education, much research has also been focused on the important question of its adoption. Rooted in Rogers' Innovation Diffusion Theory from the early 1960s, the basis for technology adoption is individuals' or institutions' perception of it as new or innovative. Since then, many theories have been developed to explain individuals' adoption of educational technology, with the most prominent being the Technology Acceptance Model (TAM) from the late 1980s and the Unified Theory of Acceptance and Use of Technology (UTAUT) from the early 2000s and their extensions (cf. Granić, 2022). Both theories emphasize that learners' actual behavior is a result of their intentions, which in turn are affected by their perceptions and other external factors. Both models define two types of individuals' perceptions: TAM to perceived usefulness and perceived ease of use, and UTAUT to performance expectancy and effort expectancy (two sets which, of course, overlap); UTAUT also adds to this mixture social influence and facilitating condition, with the latter having a potential direct link to use behavior.

Non-use of technology, through the lenses of these models, can be explained by a lack of intention to use it, which can be traced back to a lack in individuals' perceptions or other explaining factors. For example, a recent analysis of students' non-use of a Generative artificial intelligence (GenAI)-based course assistant was mostly explained by perception gaps, lack of awareness, and limited motivation, which is nicely aligned with these models (Hanshaw & Sullivan, 2025). However, while these models remain highly influential, they were not designed with systems such as GenAI in mind, where outputs are probabilistic, co-creative, and entangled with academic integrity concerns. As such, they may under-specify certain GenAI-specific factors. As was shown recently, students' interaction with GenAI is context-sensitive, and hence associated with three main factors: 1) Task characteristics, e.g., complexity, familiarity, or time constraints; 2) Decision-maker characteristics, e.g., technological proficiency, or perception of role and identity; and 3) Context characteristics, e.g., institutional resources, policy, or cultural norms (Dai, 2025).

GenAI is now widely popular in higher education, with recent surveys indicate 80%-92% of students using it at least to some extent (Mulford, 2025), doing so for a host of purposes (Hershkovitz, Tabach, & Lurie, 2025); this may explain why about two-thirds of higher education institutions globally have or are developing guidance on AI use (UNESCO, 2025). However, this widespread use may raise the question of non-use among groups of students. This question is not just intriguing, but rather important, as GenAI has some promising benefits to learners (Garzón et al., 2025; Panjabi et al., 2024). Recent studies that explicitly focused on non-use were limited by relating to a specific tool in an experiential manner (Dai, 2025), taking a top-down approach, i.e., asking about reasons that were chosen a-priori (Sousa & Cardoso, 2025), or referring to the general notion of using GenAI without referring to participants' actual non-use (Johri et al., 2024).

We bridge this gap by taking a bottom-up, qualitative approach, relying on students' own accounts of actual non-use of GenAI in academic work. Therefore, our leading research question is the following: What are the reasons for higher education students' non-use of GenAI-based tools for academic purposes?

2. Methodology

The broader study of which the current analysis is part was conducted in a large, multidisciplinary research university in Israel, with about 30,000 undergraduate and graduate students, and about 4500 faculty members; it was approved by the institution's Ethics Committee (0010309-1). Our full sample included N = 1667 students who filled out an online, anonymous survey about GenAI literacy (Hershkovitz, Tabach, Reich, et al., 2025), of which one open-response item was: "We would be happy for details regarding your use of GenAI tools for the purpose of carrying out tasks related to your studies: in the context

of which tasks do you use these tools? Which tools do you use? How often? Feel free to write whatever you want". Although the depth of individual responses is limited, such single-item prompts may elicit first-order concerns when respondents are free to reference any tools, tasks, or experiences they deem relevant.

Of the data collected via this item, there were 1045 of 1667 (63%) non-empty responses; of these 1045 non-empty responses, 901 (86%) referred to uses of GenAI-based tools for academic purposes, and they were analyzed separately (Hershkovitz, Tabach, & Lurie, 2025). Here, we analyze 144 responses (17% of 1045) in which students explicitly stated they did not use GenAI for academic purposes; of these responses, 94 included explanations for this non-use, and they are the eligible responses which served as a basis to our analysis.

Our objective was to inductively develop a thematic framework of reasons for students' non-use of GenAI for academic purposes. To this end, we conducted in a bottom-up, conventional qualitative content analysis approach to analyze students' responses. Unit of analysis was students' statements within each response, and each response could have been mapped into multiple codes. In the first phase, the first author conducted open coding on all eligible statements, generating an initial set of codes that captured distinct reasons for non-use. Similar codes were iteratively grouped and refined into five broader themes, and a detailed codebook with inclusion/exclusion criteria and example quotes was developed. In the second phase, the second author independently coded all statements using this codebook. Cohen's Kappa was calculated for each theme separately, resulting with substantial agreement values of 0.61-0.96. Discrepancies were discussed until consensus was reached, and minor refinements to code definitions were made; final theme assignment reflects this consensus coding.

3. Findings

Our thematic framework of higher education students' non-use of GenAI for academic purposes is composed of five themes (ordered by frequency, descending): Incompetency, Ineffectiveness, Ethics, Mistrust, and Harm. See Table 1 for a summary of this framework.

Incompetency. In almost half of the cases, students explicitly stated that they did not know how to use GenAI-based tools in an effective manner to support their learning. Most of them simply mentioned that they are "not familiar enough with the options" (S1601), or more bluntly, that they "have no knowledge about these tools" (S1515), or even more generally that they "know nothing about AI" (1402). Some mentioned that they "know that there are useful tools" (S612), but they do know them, and some felt that they "do not have the means to find the relevant tools" (S1165). So, they "know that it [GenAI] can really help," but they "do not know how to get to it and how to get its help" (S1535). This incompetency is not necessarily related to the lack of digital skills, as one of the participants explicitly mentioned that she is "fully capable of using digital tools," and yet "I know about the potential of GenAI-based tools' contribution, but I lack experience in this field" (S1066); furthermore, even the use of GenAI for everyday life does not necessarily impact its use for academic purposes: "I use GenAI mostly for my personal life, [for] social [issues], [for] hobbies, etc. [...] but I don't know of GenAI-based tools that can help me with practicing the material, or in creating practice-questions, giving me feedback, teaching and explaining, summarizing the material, making a work plan, etc." (S1572). Many of the responses under this theme wished to learn about potential academic uses for GenAI-based tool: "I'd love to participate in an in-depth course on the subject" (1089); "I'd be very happy to get to know these tools" (S1310); "a hands-on workshop could help me" (S1473); "I'd be happy if they [university staff] would help students in this as well, exposing them to [...] relevant tools" (S1165).

Ineffectiveness. Thirty percent of the responses referred to GenAI-based tools being unfit to support students' learning. In some cases, this was mentioned from a disciplinary perspective, however quite ironically students from both STEM and non-STEM disciplines stated that these tools may fit the "other side" of the academic disciplines but not theirs. So, on the one hand, one student wrote that "In our School of Social Work they don't know these tools, it seems like something that belongs more to STEM" (S1234), and another stated that for "scheming a good argument – [these tools are] not good and superficial" (913); on the other hand, STEM students wrote that "as a Mathematics student, there are less opportunities in which GenAI is effective" (S445), "any of the AI tools currently available are really bad at math or physics" (S1598), and "it is barely relevant for Engineering" (S1461). Other statements under this theme were related to the inability of GenAI-based tools to help in specific tasks: "I study language editing, and the existing tools are not close to be helpful" (S1500); "I study English writing [...] and my English writing [...] is of higher quality than anything GenAI can produce" (S755); "as for making presentations, which is something I often do, I'm afraid I'll waste more time explaining the AI what I need, and it's better for me to just do it by myself" (S855); "for writing a high quality academic text – AI tools are simply not good enough" (S591); "I'm aware of being able to use GenAI-based tools for searching academic materials [...], but it required much effort from me to locate the exact source" (S1133).

Ethics. Some statements related to ethical issues were relatively general, saying explicitly, e.g., that "the use of AI for writing an academic work is definitely not ethical" (S755), that "it feels to be not ethical" (S721), or at least admitting that "I am not familiar [...] with the ethical implications of the use" (S1601), or "I have no idea if it's ethical or not, so I don't take a chance" (S1210); not being sure about the ethical implications of such uses is because "there are no clear guidelines" (S914). While most these references regarded the question whether the mere use of GenAI-based tools for academic purposes is legitimate vis-à-vis institutional policies, some students referred issues of stealing – either from the point of view of the LLM or the student who uses them: "This is stealing and copyrights infringement" (S707), "It is like copying or using another students' solution" (S1376).

Mistrust. Students referred to that GenAI-based tools “output wrong information, and often invent things that don’t exist” (S1223), hence they “can’t rely on these tools” (S1038) and are “a little suspicious” (S278). They prefer to complete the task by themselves “so I can assure that everything is correct” (S1157).

Harm. A small but not negligible number of students explicitly mentioned the harm the use of GenAI-based tools can cause to their learning and to others’: “Using such tools can harm my learning and my ability to find original solutions to problems” (S445), “Using these tools for academic learning [...] characterizes lazy students who don’t enjoy the learning process and wish to submit products with no effort at all” (S492), “We talk about destructive tools that will degenerate next generation’s brains” (S1255). Some students phrased it from the other side of the coin, stating that they do not wish GenAI-based tools because they “wish to learn by myself” (S118), “I’m doing another degree for activating my brain, so it looks stupid to me to pass this effort” (S1034).

Table 1. summary description of the themes; note that themes are not mutually exclusive

Description		Count (% of 94)	Cohen’s Kappa
Incompetency	Students do not know how to use GenAI-based tools	46 (49%)	0.92
Ineffectiveness	The tools are not effective for students’ academic needs	28 (30%)	0.83
Ethics	Ethics-related issues, e.g., academic or social risks, copyrights	15 (16%)	0.96
Mistrust	GenAI produces unreliable outcomes	10 (11%)	0.61
Harm	Using GenAI actually or potentially harms learning	7 (7%)	0.71
Total		94 (100%)	

4. Discussion

In this study, we identified higher education reasons for not using GenAI for academic purposes. Overall, we find five themes (in decreasing order of frequency): Incompetency, Ineffectiveness, Ethics, Mistrust, and Harm. A recent study of students’ adoption of GenAI found that non-adopters were mostly concerned with the following: inherent limitations in GenAI outputs and misalignment between GenAI functionalities and project needs – both refer to our theme of Ineffectiveness; a lack of adaptation and prompt engineering skills, which refers to our Incompetency; and an unclear value proposition for personal development, which refer to our Harm (Dai, 2025). Factors related to Harm, Ethics, and Mistrust were found in another recent study in which students were directly asked about problematic issues regarding the use of GenAI in education (Johri et al., 2024). These correspondences to previous recent findings serve both as a validation to our findings and as evidence to the advantage of our bottom-up methodology, which resulted in a comprehensive picture of students’ reasons for not using GenAI for academic purposes.

Furthermore, the themes we identified are not fully linked with common factors related to technology acceptance which are described in classic technology adoption models like TAM or UTAUT. This highlights the need to re-examine these models’ in the context of the current GenAI era.

Notably, ethical considerations in our findings are mostly related to issues of responsibility and accountability, and not to the more commonly mentioned issues of privacy and data protection (Contreras & Jaimes, 2024). This may stem from technology use and perceptions of privacy, which differ by geographical regions (Cohen et al., 2022; Huang & Bashir, 2016), and this issue should be further studies. It is important to mention that at the time of data collection, the institution where data was collected did not have a formal policy for GenAI use. As for trust, while it has not been found as a critical factor in adoption of educational technology (Feng et al., 2025; Granić, 2022), it is found as key to the adoption of GenAI in education (Foroughi et al., 2025; Granić, 2025); this highlights the uniqueness of the current technology, and generally emphasizes the importance of a technology’s characteristics to its adoption process.

The two most prominent themes refer to students (Incompetency) and tools (Ineffectiveness), which depicts a situation in which both ends of the human-technology relationship may be perceived as flawed. These perspectives may be two sides of the same coin, and may be explained by whether the human-computer interaction is successful or not and whether the human perceives the computer as similar or dissimilar to themselves (Moon & Nass, 1998). Indeed, people often take accountability on products of their interaction with GenAI, whether it is successful or not (Du et al., 2024), which may explain why both Incompetency and Inefficiency were linked with no use. Also note that Incompetency and Ineffectiveness are inherently linked in a study based on self-report responses: a given hurdle of using GenAI-based tools may be perceived by one person as their own incompetence and by another person as the tool’s deficit.

Our least frequent theme was Harm, but so far there is only little evidence about the harm the use of GenAI causes to students; mostly, it is about the harm of using GenAI excessively (Abbas et al., 2024). Recently, it was found that when technology is perceived as causing moral harm, i.e., damaging or violating one’s values or ethical standards, people tend to not use it (Killoran, 2025); as we saw in our findings – students indeed perceive GenAI as harmful in that sense, which may explain the link between this perception and their choice to not use this technology.

Notably, the issues depicted in our themes may be addressed by taking two types of actions. First, educating students and instructors about proper GenAI uses in ways that will empower them (Steele, 2023). As the uses of GenAI-based for academic purposes are quite varied, it is required to discuss them in the context of the task to be carried out; indeed, as we demonstrated – students keep a nuanced discourse about the misfit of GenAI to specific tasks (or at least to a category of tasks), which

emphasized the need in a task-centered GenAI literacy (Hershkovitz, Tabach, Reich, et al., 2025). Second, setting up clear institutional guidelines about GenAI use by students and instructors, and keeping these guidelines flexible enough so they can be adapted to the needs of each course or each study program. In the same spirit of the required GenAI education, such policies should refer to how GenAI can help in promoting learning and teaching and not focus only on issues of misconduct in GenAI use and its threat to academic integrity (Arista et al., 2024; Jiahui, 2024).

This research is, of course, not without limitations. First, our findings are restricted by the depth and scope of the qualitative data; we relied on a single open-ended survey item and on relatively brief written responses, which do not allow for probing or follow-up questions. As such, our framework should be interpreted as an initial, exploratory mapping of salient reasons for non-use, rather than an exhaustive account of students' experiences. Second, our study was conducted in a single institution in specific educational, technological, cultural, and policy contexts. Therefore, we recommend replicating it in different educational contexts and with larger populations. Another limitation relates to the time when data collection occurred – since that time, GenAI-based tools have improved and have been adapted by more students, so it is possible that today's non-users are characterized a bit differently than the picture we portray here.

Still, we believe that our findings have important implications on promoting fruitful students' engagement with GenAI-based tools. Specifically, our five-theme framework can be directly translated into GenAI literacy and policy initiatives. For example, Incompetency suggests the need for structured, task-specific guidance and hands-on practice with GenAI tools; Ineffectiveness calls for discipline-specific exemplars of productive uses (and non-uses); Ethics and Mistrust can inform transparent, co-developed policies that clarify legitimate uses and define accountability, while teaching verification strategies; and Harm points to the importance of assessment designs and reflective activities that keep human learning at the center rather than delegating everything to GenAI.

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Exploring Pathways to Foster the Development of Core Competencies in Information Technology Course Through Interdisciplinary Learning

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Abstract: *In the digital age, digital literacy and skills stand as primary requirements for cultivating citizens, and information technology course must shoulder this responsibility. Interdisciplinary learning, as an approach that applies integrated knowledge to solve real-world problems in authentic contexts, serves as an effective pathway for developing students' core competencies. However, how to cultivate these core competencies through interdisciplinary learning methods remains an urgent issue requiring resolution. Therefore, this paper begins by elucidating the essence and characteristics of interdisciplinary learning. It then analyzes the four significant values of interdisciplinary learning in promoting the development of subject-specific core competencies. Furthermore, it proposes four specific practical pathways: establishing a teaching philosophy of interdisciplinary teaching, defining instructional objectives and designs supported by big ideas, designing authentic learning activities, and conducting dynamic performance evaluation. This aims to provide teachers with reference experiences and foster the development and enhancement of students' core competencies.*

Keywords: Interdisciplinary learning, Information technology course, Core competencies, Curriculum standards

1. Introduction

The rapid advancement of digital technology demands societal transformation and upgrading, triggering profound changes across all domains of social production and daily life. However, traditional educational models can no longer meet the demands of transformation in the digital age. Therefore, to address the challenges of the 21st-century knowledge economy, globalization, and informatization, many countries have proposed frameworks of core competencies for citizens, which essentially reflect a demand for upgrading educational quality (Chu, H. Q., 2022). In a digital society reshaped by intelligent technologies, “digital literacy and skills” have become a crucial component of core competencies and are increasingly recognized as key indicators for measuring international competitiveness and soft power (Central Cyberspace Affairs Commission, 2021). Information technology course will serve as a vital vehicle for cultivating these digital literacy and skills. The “Compulsory Education Information Technology Course Standards” issued in 2022 introduced four core subject competencies that share intrinsic commonalities and aligned objectives with “digital literacy and skills” (Ren, Y. Q., Huang, R. H., & Xiong, Z., 2022). And the standard emphasizes the experience and practice in specific contexts of the digital society, as well as the competency for the digital environment (Chen, M. X., & Lai, Z. L., 2020). Therefore, to cultivate students' core competencies, the information technology course must adopt interdisciplinary learning methods that transcend disciplinary boundaries, integrate content, create authentic learning contexts, incorporate real-world problems and practical activities, and foster meaningful learning experiences.

However, current interdisciplinary learning faces several challenges. For instance, teachers often simplistically view it as a mere collage of knowledge from various subjects. Instructional objectives remain primarily focused on knowledge acquisition, and some interdisciplinary learning activities are designed only superficially or at a shallow level. Evaluation systems are monotonous, failing to reflect the effectiveness of cultivating students' core competencies. These issues significantly hinder the development and enhancement of students' core competencies. How to effectively organize and implement interdisciplinary learning to promote the development of students' core competencies in information technology course will be the central issue explored in this study. Based on this, the study examines the connotations of interdisciplinary learning and core competencies, analyzes the significance and value of interdisciplinary learning in fostering students' core competencies in information technology course, and proposes several practical pathways. The aim is to provide reference experiences for educational practitioners, promote the development and enhancement of students' core competencies, and cultivate innovative and versatile talents capable of meeting the development demands of a digital society.

2. What: The Essence of Interdisciplinary Learning and Core Competencies

2.1. The Essence and Characteristics of Interdisciplinary Learning

Interdisciplinary learning aims to break down barriers between disciplines and establish meaningful, valuable connections across multiple disciplines (Gu, X. Q., & Jiang, B. Q., 2023). It emphasizes the learning of a certain subject in authentic, complex, and meaningful contexts, and the need to integrate knowledge, skills, and ways of thinking from other subjects to jointly solve the problems of the subject in order to promote the development and improvement of students' core competencies in the subject.

Interdisciplinary learning has three key characteristics: First, integrative. The problems or tasks in interdisciplinary learning are complex and cannot be solved using knowledge from a single discipline alone. Therefore, we must integrate

knowledge, skills, and ways of thinking from other disciplines to address these problems. However, this does not mean merely stacking knowledge from other disciplines together simply. The integration here involves more of students' higher-order cognitive thinking, requiring students to meaningfully connect, integrate, and reconstruct knowledge across disciplines. Second, practical. Interdisciplinary learning emphasizes students' practical operations and personal experiences, enabling them to learn by doing. Only through this learning method, students can gain authentic learning experiences and apply knowledge comprehensively to solve problems in real-life contexts. Third, authentic. According to Ausubel's theory of meaningful learning, interdisciplinary learning requires integrating knowledge together so that students can grasp its practical significance. Pure knowledge teaching will hinder students to connect knowledge, as knowledge is isolated and abstract. But linking knowledge learning with real life problems, can encourage students to move knowledge from "scattered" to "integrated", and transform and reconstruct it in the process of problem-solving (Gu, X. Q., & Jiang, B. Q., 2023), making the acquired knowledge have practical significance.

2.2. The Essence and Importance of Core Competencies

Core competencies represent the concentrated manifestation of a curriculum's educational value, embodying the correct values, essential represent the concentrated manifestation character traits, and key abilities that students progressively develop through coursework (Ministry of Education of the People's Republic of China., 2022). The core competencies cultivated by the information technology course primarily include information awareness, computational thinking, digital learning and innovation, and information societal responsibility (Ministry of Education of the People's Republic of China., 2022). Among these, information awareness refers to an individual's sensitivity to information and their ability to judge its value, constituting the objective reflection of information within the human mind (Ministry of Education of the People's Republic of China., 2022); Computational thinking refers to the individual's application of scientific methods from the field of computer science and the thinking activity of abstraction, decomposition, modeling, algorithm design, etc. involved in the process of problem-solving. This is the core competency that best reflects the essence of information technology course (Ministry of Education of the People's Republic of China., 2022); Digital learning and innovation signify individuals' effective utilization of digital resources and engagement in creative exploration within daily learning and life, and they are the sustainable development of people in digital environments (Gu, X. Q., & Jiang, B. Q., 2023); Information social responsibility refers to the duties that individuals should undertake in terms of cultural cultivation, ethical norms, and behavioral self-discipline within the information society, representing a moral quality (Ministry of Education of the People's Republic of China., 2022).

These four core competencies mutually reinforce and permeate one another, collectively advancing students' digital knowledge and skills. They empower students to develop into innovative and versatile talents capable of meeting the development demands of a digital society, grow into well-rounded socialist builders and successors who excel in moral, intellectual, physical, aesthetic, and labor education, and emerge as a new generation ready to shoulder the great rejuvenation of the Chinese nation.

3. Why: The Value of Foster the Development of Core Competencies in Information Technology

Course Through Interdisciplinary Learning

Interdisciplinary learning is characterized by its integrative, practical, and authentic nature, playing a positive role in cultivating students' core competencies.

3.1. Interdisciplinary Learning is Well-suited to the Nature of Information Technology Course

Information technology course is an interdisciplinary subject that integrates knowledge and skills from multiple disciplines, including computer science, information science, cognitive science, mathematics, the arts, and language arts. By its very nature, it embodies the characteristics of interdisciplinary learning. Furthermore, information technology course primarily addresses real-world problems that cannot be solved by relying solely on the knowledge and skills of a single discipline; rather, they require breaking down disciplinary boundaries, integrating diverse knowledge, and engaging in systematic thinking. Furthermore, with the development of information technology, technology has deeply penetrated every sector of society, and a large number of emerging and interdisciplinary fields are emerging (Dabu, C.-M., 2017). This inevitably compels information technology course to adopt interdisciplinary learning approaches, thereby providing talent and technical support for the development of other scientific fields.

3.2. Interdisciplinary Learning is the Essential Approach for the Cultivation of Core Competencies in Information

Technology Course

Interdisciplinary learning is an educational model for achieving comprehensive character education (Li, J. T., 2022). The four core competencies of the information technology course emphasize the practical application of IT in daily life, focusing on cultivating students' comprehensive abilities to address challenges in the digital society. This demonstrates that knowledge acquisition confined to a single discipline cannot enable students to establish connections between different fields of knowledge or develop integrated analytical and problem-solving skills. Interdisciplinary learning, as a decentralized knowledge model, breaks down disciplinary boundaries to form a vertically integrated and horizontally interconnected structure of core competencies (Li, G., & Lyu, L. J., 2018). This facilitates students' integration of multidisciplinary knowledge,

reconstruction of their knowledge systems, and development of comprehensive abilities to analyze and solve real-world problems. Consequently, it promotes the advancement and enhancement of their core competencies in the information technology course. Therefore, interdisciplinary learning responds to the cultivation requirements of core competencies and is the inevitable choice for the cultivation of core competencies in information technology course.

3.3. Enhance Students' Practical and Innovative Abilities

Interdisciplinary learning emphasizes learning within authentic, complex, and meaningful contexts, enabling students to solve complex, real-world, integrated problems. It prioritizes hands-on activities and firsthand experiences, allowing students to learn by doing. This approach provides students with the most authentic learning experiences and enhances their practical skills. Furthermore, interdisciplinary learning emphasizes the intersection and integration of knowledge across different disciplines, while providing students with an open and flexible learning environment. This helps stimulate new ideas and boosts their innovative capabilities. For example, in the practical project of designing an online digital weather station, students must integrate knowledge from information technology, mathematics, physics, geography, and art. They personally select a site on campus, determine the station's design style, and construct multiple online digital weather station bases that harmonize with the surrounding environment, while dynamically collecting and analyzing data. At the same time, a school-wide collaborative network is established to allow all students to participate, thereby generating new ideas and designs through collaboration on a larger scale.

3.4. Integrate Students' Knowledge Structure

The greatest strength of interdisciplinary learning lies in its ability to help students transcend the boundaries of single-subject knowledge. It integrates and connects knowledge, skills, and ways of thinking across disciplines, reconstructing students' knowledge systems and broadening their intellectual horizons. For instance, in the interdisciplinary unit "Exploring Data Encoding" within the information technology course, students not only acquire knowledge about data encoding within IT but also learn concepts related to mathematical arithmetic, data protection in Ethics and Law, scientific principles, artistic appreciation, and language expression. This approach transforms IT and its related subjects from dry topics into engaging learning experiences that spark students' enthusiasm and curiosity. It enables them to understand the connections between different disciplines and appreciate the depth and richness of knowledge (Zhang, X. Y., 2024).

4. How: Practical Pathways to Foster the Development of Core Competencies in Information

Technology Course Through Interdisciplinary Learning

In the information technology course, fostering the development of students' core competencies through interdisciplinary learning requires, above all, a shift away from subject-based educational philosophies and teaching approaches that primarily focus on imparting technical knowledge and training operational skills.

4.1. Establish a Teaching Philosophy of Interdisciplinary Teaching

The transformation of teachers' teaching philosophy is crucial for the successful implementation of interdisciplinary learning and the cultivation of students' core competencies. First, teachers must clearly understand the nature of the information technology course and recognize that it is a practical and interdisciplinary subject. Second, teachers must recognize the vital role interdisciplinary learning plays in advancing students' core competencies. They should be willing to embrace and experiment with interdisciplinary approaches, establishing a teaching philosophy centered on such learning. This philosophy must be integrated into their instructional goal design, lesson activity planning, and assessment implementation to ensure the smooth execution of interdisciplinary learning and enhance students' core competencies. In addition, teachers should be adept at identifying real-life examples and establishing meaningful connections with the curriculum content, thereby facilitating interdisciplinary learning. For example, regarding the "Artificial Intelligence and Smart Society" content module mentioned in the "Compulsory Education Information Technology Course Standards (2022 Edition)", teachers should not define it simply as an artificial intelligence principles course or a technical operation course based on traditional concepts and teach it accordingly. Instead, they should regard it as a systematic practical project situated in authentic, complex, and meaningful contexts, and address it as such."

4.2. Define Instructional Objectives and Designs Supported by Big Ideas

Traditional information technology course focus solely on the subject itself, primarily teaching IT knowledge and skills. While objectives are easy to establish, this approach conflicts with the interdisciplinary learning emphasized in the compulsory curriculum standards. Interdisciplinary learning emphasizes the integration of knowledge across multiple disciplines, creating open learning contexts with complex problems. The learning content involved far exceeds the scope of teaching materials, making objective setting challenging under such circumstances. Therefore, to circumvent this issue of excessive content, we can design instructional objectives supported by big ideas. Big ideas refer to core concepts or themes that span multiple disciplines or knowledge points, possessing strong transfer value. They effectively organize fragmented knowledge and skills for application in solving real-world problems (Gu, X. Q., & Jiang, B. Q., 2023). Thus, in interdisciplinary learning activities, we can identify big ideas relevant to the activity's theme across the involved disciplines. This approach eliminates irrelevant content, clarifies instructional objectives, and better cultivates students' core competencies. Taking the section "Envisioning

Future Intelligent Scenarios” from the “Compulsory Education Information Technology Course Standards (2022 Edition)” as an example, we can create a problem scenario of “Designing a Virtual Tutor”. This task involves knowledge from information technology, Chinese language, art, and other disciplines. So, learning objectives and activities can be structured around the big idea of “Proper Information Processing”, which not only reflects the core competencies of the information technology course but also highlights the core concepts and competencies of other disciplines, as illustrated in Figure 1.

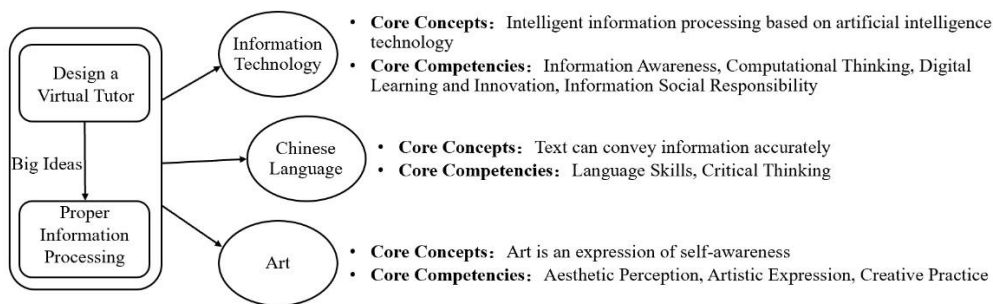


Figure 1. The big idea of “Designing a Virtual Tutor”

4.3. Design Authentic Learning Activities

Today we live in a digital age where digital technology permeates every aspect of our production and daily life. It is present in everyday communication, learning, work, transportation, home life, dining, shopping, and more. Therefore, as the primary vehicle for cultivating citizens' digital literacy, the information technology course should draw its interdisciplinary learning themes from real-world problems encountered in authentic life scenarios. This approach fosters computational thinking in students—the ability to apply integrated knowledge to analyze and solve practical issues—while also helping them develop information awareness, digital learning and innovation capabilities, and a sense of responsibility in the information society. Ultimately, this promotes the growth and enhancement of students' digital literacy. The “Design a Virtual Tutor” practical activity is closely tied to students' actual learning experiences. During the learning process, teachers cannot be by students' sides at all times. When students encounter difficulties, they can turn to the virtual tutor for solutions.

4.4. Conduct Dynamic Performance Evaluation

The “Compulsory Education Information Technology Course Standards (2022 Edition)” emphasizes strengthening performance evaluation and refining summative assessment. Performance evaluation should reflect authenticity of evaluation contexts, diversity of assessment methods, plurality of evaluators, comprehensiveness of assessment content, and guidance through feedback (Ministry of Education of the People's Republic of China., 2022). Moreover, interdisciplinary learning focuses on cultivating students' core competencies through solving real-world problems in authentic contexts, highlighting behavioral performance during the learning process. Therefore, dynamic performance evaluation can be implemented, where students' learning behaviors, problem-solving abilities, and final projects all constitute evaluation components. This facilitates teachers' clear understanding and assessment of students' core competency development during learning activities, enabling corresponding instructional reflection and improvement. For example, in the “Design a Virtual Tutor” practical activity, evaluation criteria may include group discussion records, design proposals, and the presentation of final projects. Furthermore, teachers should emphasize the diversity of evaluators, upload student work to a centralized online platform, and encourage students, teachers, and parents to participate in the evaluation process.

5. Summary

Interdisciplinary learning, as an approach that applies integrated knowledge to solve real-world problems in authentic contexts, effectively addresses the 21st-century demand for cultivating citizens' digital literacy and skills. It positively impacts students' practical abilities, enhances their innovative capabilities, and integrates their knowledge structures. However, interdisciplinary learning currently faces certain challenges, requiring us to continuously explore and actively refine teaching philosophies, instructional goal design, teaching activities, and assessment methods to better foster the development and enhancement of students' core competencies.

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Learning Electrical Engineering Through Authentic Measurement: A TPACK-Guided Solar STEAM Car Intervention in K–12 STEM Education

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Abstract: *Persistent misconceptions in electrical engineering (EE), such as confusion between voltage and current and misunderstandings of battery behavior, remain common among K–12 students. One contributing factor is the prevalence of abstract and idealized instruction that limits students’ engagement with real electrical systems. This study examines a TPACK-guided instructional intervention using a Solar STEAM Car that integrates photovoltaic panels, battery storage, and authentic measurement tools to support learning in an applied engineering context. A mixed-methods design was employed with 124 secondary students, including pre- and post-tests of conceptual understanding and performance-based assessments of measurement and engineering reasoning. Paired-samples *t* tests revealed significant gains in overall EE conceptual understanding, subscale concepts, and performance outcomes ($p < .001$). The findings suggest that when authentic electrical systems are pedagogically aligned through TPACK-informed design, students’ conceptual understanding and data-driven engineering reasoning can be substantially improved beyond what is typically achieved through abstract or simulation-based instruction.*

Keywords: TPACK, electrical engineering education, solar energy, authentic learning, STEM education

1. Introduction

Electrical engineering (EE) concepts such as voltage, current, power, and energy storage form a foundational component of STEM education. Despite sustained curricular attention, research consistently shows that secondary-level students struggle to develop coherent understandings of these concepts, often retaining misconceptions even after formal instruction (Aykutlu & Şen, 2012; Bauman et al., 2024). Common difficulties include conflating voltage with current, believing that current is “consumed” by loads, and equating a battery’s instantaneous voltage with its state of charge (SOC) (Turgut et al., 2011; Eshetu & Alemu, 2018).

One key reason for these persistent difficulties lies in the instructional contexts commonly used in K–12 classrooms. EE concepts are frequently taught through idealized circuit diagrams, symbolic equations, or simulations that fail to represent the non-ideal, dynamic behavior of real systems. While such representations are valuable for introducing theoretical relationships, they rarely expose students to authentic measurement data or system-level interactions, limiting opportunities for conceptual refinement (Chekour et al., 2022; Aligo et al., 2021).

From a learning-theoretical perspective, situated and authentic learning theories argue that understanding develops through participation in meaningful disciplinary practices rather than through decontextualized symbol manipulation (Lave & Wenger, 1991; Engström, 2024). In engineering education, this implies engaging learners with actual systems, measurement tools, and data. Although mobile and portable STEM laboratories have attempted to address this need, empirical evidence regarding their impact on EE conceptual understanding remains limited (DeJarnette et al., 2021).

The Technological Pedagogical Content Knowledge (TPACK) framework provides a useful lens for examining how technology can support learning when aligned with pedagogy and disciplinary content (Mishra & Koehler, 2006; Voogt et al., 2012). However, most TPACK-based studies in STEM education focus on digital or virtual tools such as simulations or data-visualization platforms. The pedagogical role of physical measurement technologies embedded in authentic electrical systems remains underexplored.

To address this gap, the present study investigates a TPACK-guided Solar STEAM Car intervention that integrates photovoltaic generation, battery storage, and real-time electrical measurement. The study examines whether such an intervention can improve students’ EE conceptual understanding and support the development of data-driven engineering reasoning.

The study is guided by the following research questions:

RQ1: Does participation in a Solar STEAM Car intervention lead to significant gains in students’ EE conceptual understanding?

RQ2: How does engagement with authentic measurement tasks influence students’ performance and engineering reasoning?

2. Theoretical Background

This study adopts TPACK as a design logic rather than a descriptive taxonomy. TPACK emphasizes that technology contributes to learning only when meaningfully integrated with appropriate pedagogical strategies and core disciplinary concepts (Mishra & Koehler, 2006; Schmidt et al., 2009). In the context of EE education, technological knowledge encompasses not only digital tools but also physical measurement instruments—such as digital multimeters and current sensors—that mediate learners’ interaction with electrical systems.

Situated learning theory further suggests that knowledge is constructed through participation in authentic practices (Lave & Wenger, 1991). In EE learning, such practices include measuring voltage and current, interpreting power data, and reasoning about system behavior under varying conditions. Measurement thus functions not merely as a technical skill but as an epistemic practice through which learners test predictions, confront misconceptions, and refine conceptual understanding (Eshetu & Alemu, 2018; Bauman et al., 2024).

By integrating authentic measurement tools within an inquiry-oriented pedagogy, a TPACK-guided approach has the potential to bridge abstract EE concepts with real-world system behavior. The present study operationalizes this integration through a Solar STEAM Car that serves as a portable micro-energy system for learning.

3. Method

3.1. Participants and Context

Participants were 124 secondary school students from two schools. Students were enrolled in regular STEM courses and had received prior instruction on basic electrical concepts. Four teachers with at least five years of STEM teaching experience implemented the intervention after participating in a half-day orientation focused on system operation and instructional procedures.

3.2. Instructional Intervention

The Solar STEAM Car integrates photovoltaic panels, a battery storage system, DC loads, digital multimeters, and current sensors. The instructional intervention consisted of four 70-minute sessions delivered over three weeks. Activities were structured using a prediction–observation–explanation (POE) inquiry model.

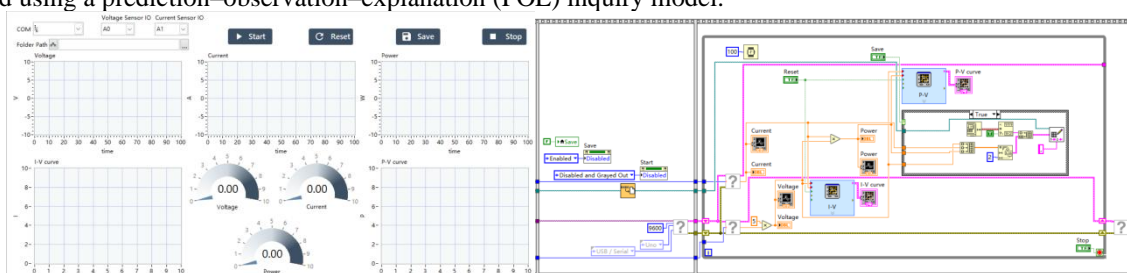


Figure 1. User interface and block-diagram architecture of the Solar Monitoring System developed using LabVIEW.

Students measured battery voltage and current under different load conditions, investigated the effects of irradiance and shading on solar output, and calculated electrical power using measured data. In the final session, students completed an engineering design task requiring justification of load-selection decisions based on collected measurements.

3.3. Measures and Data Analysis

Conceptual understanding was assessed using a 20-item test with three subscales: circuit concepts, solar concepts, and battery concepts (overall reliability $\alpha = .82$). Performance was assessed using a rubric evaluating instrument operation, data recording, data interpretation, and engineering reasoning (maximum score = 12).

Table 1. Paired-samples t tests were conducted to compare pre- and post-test scores for all measures.

Measure	Indicator (Max Score)	Pre-test M (SD)	Post-test M (SD)	t(df)	p
Conceptual Understanding (Total)	Overall EE concepts (20)	9.8 (3.1)	14.7 (2.9)	18.16 (123)	< .001
Circuit Concepts	Voltage, current, power (8)	3.7 (1.4)	6.1 (1.3)	14.02 (123)	< .001

Solar Concepts	Irradiance, shading, output (6)	2.4 (1.2)	4.3 (1.1)	>10.00 (123)	< .001
Battery Concepts	SOC, discharge behavior (6)	3.7 (1.0)	4.3 (0.9)	>7.00 (123)	< .001
Performance Assessment	Measurement & engineering reasoning (12)	5.3 (2.1)	9.1 (1.8)	15.27 (123)	< .001

Note: Paired-samples *t* tests were conducted for all comparisons. EE = electrical engineering.

4. Results

4.1. Conceptual Understanding

Students demonstrated significant gains in overall EE conceptual understanding following the intervention. Mean scores increased from $M = 9.8$ ($SD = 3.1$) on the pre-test to $M = 14.7$ ($SD = 2.9$) on the post-test, $t(123) = 18.16$, $p < .001$.

Subscale analyses revealed significant improvements across all domains. Circuit concept scores increased from $M = 3.7$ ($SD = 1.4$) to $M = 6.1$ ($SD = 1.3$), $t(123) = 14.02$, $p < .001$. Solar concept scores increased from $M = 2.4$ ($SD = 1.2$) to $M = 4.3$ ($SD = 1.1$), $t(123) > 10.00$, $p < .001$. Battery concept scores also improved significantly, from $M = 3.7$ ($SD = 1.0$) to $M = 4.3$ ($SD = 0.9$), $t(123) > 7.00$, $p < .001$.

4.2. Performance Assessment

Performance assessment scores increased from $M = 5.3$ ($SD = 2.1$) to $M = 9.1$ ($SD = 1.8$), $t(123) = 15.27$, $p < .001$. Improvements were most pronounced in data interpretation and engineering reasoning, with students increasingly using measured voltage, current, and power values to justify their conclusions.

5. Discussion and Limitations

The results indicate that the Solar STEAM Car intervention significantly improved students' EE conceptual understanding and performance. Importantly, these gains do not stem from the technology itself but from the pedagogically structured use of authentic measurement data within a TPACK-guided design. This finding aligns with situated learning theory, which emphasizes the role of authentic practice in conceptual development (Lave & Wenger, 1991; Engström, 2024).

By engaging with non-ideal system behavior and real measurement values, students were able to confront and revise prior misconceptions that often persist under abstract instruction. The findings support prior research suggesting that measurement-centered learning environments can facilitate conceptual change in EE education (Bauman et al., 2024; Chekour et al., 2022).

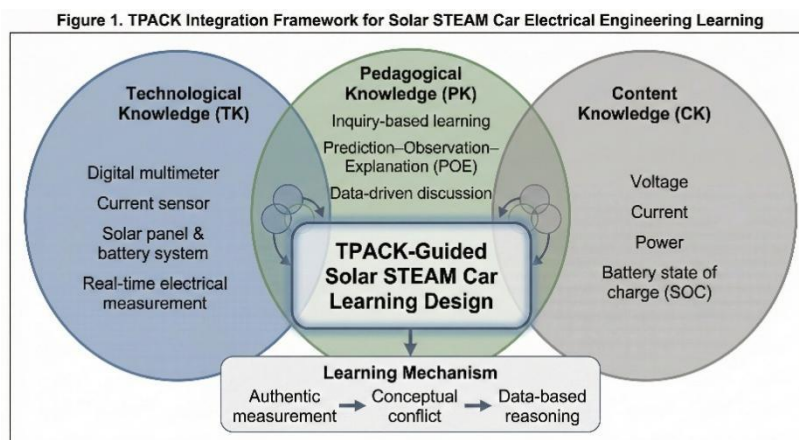


Figure 2. Conceptual framework of the TPACK-guided Solar STEAM Car intervention

Several limitations should be noted. The intervention was of relatively short duration, and the study was conducted in a specific educational context, which may limit generalizability. Additionally, novelty effects associated with working in a

mobile solar laboratory cannot be fully ruled out (DeJarnette et al., 2021). Future research should examine longer-term retention and explore similar interventions across diverse settings.

6. Conclusion

This study demonstrates that a TPACK-guided Solar STEAM Car intervention can effectively support secondary students' learning of core EE concepts. By integrating authentic electrical systems and measurement tasks within inquiry-based pedagogy, the intervention promoted meaningful conceptual change and data-driven engineering reasoning. The findings offer a theoretically grounded model for incorporating real engineering systems into K–12 STEM education.

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Gender Differences in AI-Assisted Invention Camp: An Analysis of Learning Interest, Flow Experience, Cognitive Load, Aha-Moments, Questioning Ability, and Inventive Satisfaction

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Abstract: *The integration of Artificial Intelligence (AI) into invention education offers a transformative approach to fostering students' creativity, problem-solving, and reflective thinking. This study investigated gender differences in learning experience and psychological engagement during an AI-Assisted Invention Camp designed to train students to ideate, prototype, and refine inventions for participation in the International Exhibition for Young Inventors (IEYI). A total of sixty-seven students from elementary, junior-high, and senior-high levels (45 males and 22 females) participated in the two-day camp that combined project-based learning with AI-assisted inquiry and the SCAMPER creative-thinking strategy. Participants completed a post-program questionnaire assessing six constructs: Learning Interest, Flow Experience, Cognitive Load, Aha-Moments, Questioning Ability, and Inventive Satisfaction. Independent-samples t-tests revealed that male students exhibited higher questioning ability and inventive satisfaction, whereas no significant gender differences were found in learning interest, flow experience, cognitive load, or Aha-Moments. The results suggest that AI-supported invention learning provides an inclusive and cognitively balanced environment, while also highlighting subtle differences in analytical and affective engagement across genders. These findings contribute to the understanding of gender-responsive pedagogy in AI-integrated STEM and invention education.*

Keywords: AI-Assisted Invention, Gender Differences, Flow Experience, IEYI, SCAMPER

1. Introduction

The integration of Artificial Intelligence (AI) into education has transformed how students generate ideas, engage in creative inquiry, and construct knowledge. Recent studies highlight that AI technologies—such as generative models, intelligent tutoring systems, and adaptive learning platforms—have significantly enhanced learners' creativity, problem-solving abilities, and personalized learning experiences (Maity & Deroy, 2024). In the field of invention education, AI functions as a cognitive partner that helps learners explore design possibilities, visualize prototypes, and refine concepts through iterative feedback (Goyal, 2025). The development of AI-based invention programs has been recognized as an emerging pedagogical approach that fosters innovation and prepares students for future STEM and creative industries (Ofosu-Ampong, 2023).

Building on these advancements, the AI-Assisted Invention Camp was designed to help Taiwanese students develop creative thinking and technical skills while preparing for participation in the International Exhibition for Young Inventors (IEYI). The camp combined project-based and inquiry-based learning with generative AI applications, providing a dynamic environment in which learners could experience both the creative and analytical dimensions of innovation. In particular, the program integrated the SCAMPER creative-thinking strategy—encouraging students to Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, and Reverse design elements—to systematically expand and evaluate their invention ideas. Through AI-assisted brainstorming using ChatGPT and Gemini, students extended SCAMPER-generated concepts into concrete prototypes, supported by visual ideation and refinement in Midjourney.

Grounded in Gender Schema Theory (Bem, 1981), this study assumes that students' learning behaviors and self-perceptions are influenced by internalized social beliefs about gender roles. These schemas affect how learners approach technology, problem-solving, and creative collaboration. Recent studies in STEM and AI-supported education have reported that males often display higher technological confidence and exploratory behavior, whereas females tend to demonstrate stronger emotional engagement, persistence, and teamwork (Ofosu-Ampong, 2023). Other research has also shown that gender differences can influence learners' flow experience, cognitive load management, and satisfaction when interacting with AI-based learning environments (Sofi et al., 2025, Lee et al., 2025).

However, very few studies have examined these gender-related differences within the context of AI-assisted invention education, particularly in relation to the constructs of Learning Interest, Flow Experience, Cognitive Loading, Aha-Moments, Questioning Ability, and Inventive Satisfaction. Most existing studies have focused on AI use in general learning motivation or problem-solving tasks (Yang, 2024), leaving a gap in understanding how AI and structured creative frameworks such as SCAMPER influence students' cognitive and affective engagement in inventive practice. The present study therefore addresses this research gap by exploring gender differences across these six dimensions, aiming to provide new insights into inclusive and creativity-oriented STEM pedagogy.

2. Methodology

Sixty-seven students from elementary, junior-high, and senior-high levels participated in the study, including forty-five males (67.2 %) and twenty-two females (32.8 %). All students completed both days of the camp and responded to a post-program questionnaire.

The two-day workshop, titled Empower Innovation with AI, Unlock Infinite Creativity, blended project-based learning with AI-assisted inquiry. Students used ChatGPT and Gemini to extend ideas generated through the SCAMPER creative-thinking method, conducted patent and market analyses with AI tools, and applied engineering principles in mechanism and sensor design. Midjourney was employed to visualize prototype sketches, while structured reflection sessions encouraged learners to record their Aha-Moments and formulate guiding questions for further improvement. Through this process, participants engaged in authentic cycles of ideation, evaluation, and refinement that mirror real-world invention development.

The questionnaire consisted of six subscales, each rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Learning Interest (Shin et al., 2019) assessed motivation and curiosity toward invention learning; Flow Experience (Rodríguez-Sánchez et al., 2011) captured deep, enjoyable immersion in tasks; Cognitive Load (Ouwehand et al., 2021) measured perceived mental effort in handling AI tools and complex designs; Aha-Moments (Kounios & Beeman, 2009) referred to sudden insights or conceptual breakthroughs; Questioning Ability (Rahmatih et al., 2021) evaluated students' capacity to generate reflective and analytical questions; and Inventive Satisfaction (Ivanov & Cyr, 2014) represented overall fulfillment with the invention process and outcomes. All scales demonstrated satisfactory reliability, with Cronbach's α values ranging from .85 to .92. Data were analyzed using independent-samples t-tests to compare gender means at a significance level of $p < .05$.

3. Result

An independent-samples t-test was conducted to examine gender differences between male and female students in terms of Learning Interest, Flow Experience, Cognitive Load, Aha-Moments, Questioning Ability, and Inventive Satisfaction. The results are summarized in Table 1.

Table 1. Gender differences across constructs.

Construct	Gender	N	M	SD	t-value
Learning Interest	Male	45	4.01	0.68	3.397
	Female	22	4.00	0.52	
Flow Experience	Male	45	3.69	0.76	0.966
	Female	22	3.88	0.66	
Cognitive Load	Male	45	3.07	0.92	0.346
	Female	22	3.02	0.91	
Aha-Moments	Male	45	3.89	0.74	3.370
	Female	22	4.06	0.54	
Questioning Ability	Male	45	3.87	0.74	5.515*
	Female	22	3.69	0.52	
Inventive Satisfaction	Male	45	3.93	0.80	9.599**
	Female	22	4.06	0.39	

Results indicated that male participants ($M = 4.01$, $SD = 0.68$) and female participants ($M = 4.00$, $SD = 0.52$) demonstrated nearly identical levels of learning interest, with no significant difference ($t = 3.397$, $p > .05$). For flow experience, males ($M = 3.69$, $SD = 0.76$) and females ($M = 3.88$, $SD = 0.66$) showed comparable engagement levels ($t = 0.966$, $p > .05$), suggesting that both groups experienced a similar degree of immersion during the invention activities. Cognitive load did not significantly differ between genders, with male students ($M = 3.07$, $SD = 0.92$) and female students ($M = 3.02$, $SD = 0.91$) reporting nearly equivalent perceived mental effort ($t = 0.346$, $p > .05$). Similarly, the analysis of Aha-Moments revealed no significant distinction, as male participants ($M = 3.89$, $SD = 0.74$) and female participants ($M = 4.06$, $SD = 0.54$) experienced comparable levels of insight and sudden realization during the creative process ($t = 3.370$, $p > .05$). In contrast, significant gender differences emerged in Questioning Ability and Inventive Satisfaction. Male students ($M = 3.87$, $SD = 0.74$) scored significantly higher than female students ($M = 3.69$, $SD = 0.52$) in Questioning Ability ($t = 5.515$, $p < .05$), indicating a stronger tendency among males to raise analytical or reflective questions during design discussions. Additionally, Inventive Satisfaction showed a notable difference, with males ($M = 3.93$, $SD = 0.80$) reporting higher satisfaction than females ($M = 4.06$, $SD = 0.39$) ($t = 9.599$, $p < .01$). Overall, the statistical outcomes suggest that both genders experienced comparable levels of engagement, cognitive demand, and insight in the AI-Assisted Invention Camp. However, male participants demonstrated slightly stronger questioning ability and greater inventive satisfaction, highlighting subtle differences in reflective engagement and emotional response to the inventive learning experience.

4. Discussion

The findings of this study reveal nuanced gender-related patterns in the learning experiences of students participating in the AI-Assisted Invention Camp. Overall, both male and female participants demonstrated similar levels of learning interest, flow experience, cognitive load, and Aha-Moments, suggesting that the AI-integrated invention environment provided an equally engaging and cognitively manageable experience for both groups. The comparable results across these dimensions indicate that the camp's structure—combining AI-assisted ideation, SCAMPER-based creative thinking, design visualization, and reflective inquiry—effectively minimized gender disparities in cognitive effort and conceptual insight. By allowing students to apply the SCAMPER framework (Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, and Reverse) with the support of AI tools, the program provided a structured yet flexible method for idea expansion that encouraged both divergent and convergent thinking.

However, two constructs—Questioning Ability and Inventive Satisfaction—showed significant gender differences, with male students outperforming females. Male participants exhibited stronger questioning ability, indicating a greater inclination toward analytical reasoning and critical inquiry during the design process. This pattern is consistent with prior research suggesting that male learners tend to express higher confidence in technical exploration and self-directed problem analysis (Yau & Cheng, 2012). Their higher Inventive Satisfaction scores further suggest that they derived more fulfillment from the iterative design and problem-solving aspects of invention learning. Such outcomes may stem from greater familiarity or prior exposure to hands-on STEM or robotics experiences, which can strengthen both technical confidence and perceived achievement.

In contrast, female students' comparable performance across most constructs highlights their capacity to engage effectively in AI-based invention learning when provided with adequate support and collaborative opportunities. Although their questioning scores were slightly lower, the absence of large disparities in cognitive load and flow experience suggests that female learners were equally capable of handling technical challenges and maintaining emotional engagement throughout the inventive process. The SCAMPER model may have particularly benefited female participants by guiding their creative exploration in a systematic and non-competitive manner, promoting confidence in idea generation and refinement. This finding resonates with previous literature emphasizing that when instructional designs promote inclusivity, reflective learning, and creative expression, female learners demonstrate engagement levels like their male counterparts (Lin et al., 2019).

Pedagogically, these results underscore the potential of AI-assisted invention programs to serve as equitable platforms for creativity and innovation. The integration of AI tools such as ChatGPT, Gemini, and Midjourney allowed learners to translate abstract ideas into tangible concepts while receiving immediate feedback and cognitive scaffolding. Combined with SCAMPER's structured creativity process, students were able to deconstruct problems, explore alternatives, and reimagine solutions through iterative questioning. This technological and cognitive mediation appears to have reduced the mental demands traditionally associated with invention design, enabling both genders to focus on higher-order thinking, conceptual integration, and reflective reasoning. Furthermore, the incorporation of Aha-Moment reflection and SCAMPER-based questioning promoted metacognitive awareness—an essential attribute for continuous improvement and inventive thinking.

Moving forward, the slight advantage observed among male students in questioning and satisfaction suggests a need for instructional adjustments that encourage female learners to take more active roles in analytical discussions and design evaluation. Strategies such as guided questioning templates, mixed-gender collaboration, and reflection logs aligned with SCAMPER prompts could balance engagement patterns and ensure that both groups fully benefit from AI-supported creative inquiry. Overall, the findings confirm that when designed with cognitive equity, structured creativity, and reflective practice in mind, AI-assisted invention education can effectively cultivate creativity, curiosity, and confidence among diverse learners preparing for global competitions such as the International Exhibition for Young Inventors (IEYI).

5. Conclusions

This study investigated gender differences in six learning constructs—Learning Interest, Flow Experience, Cognitive Load, Aha-Moments, Questioning Ability, and Inventive Satisfaction—among participants of an AI-Assisted Invention Camp designed to cultivate creativity and innovation for the International Exhibition for Young Inventors (IEYI). The results indicated that male and female students shared similar levels of interest, engagement, cognitive demand, and insight experiences, reflecting that the AI-enhanced invention learning environment provided balanced opportunities for both genders. However, male participants exhibited higher questioning ability and greater inventive satisfaction, suggesting a tendency toward more analytical engagement and stronger emotional reward from the inventive process.

These findings demonstrate that integrating AI tools such as ChatGPT, Gemini, and Midjourney into invention education can support cognitive equity while encouraging distinct yet complementary forms of engagement across genders. The technology's ability to scaffold ideation, visualize prototypes, and prompt reflective questioning helps reduce learning barriers and promotes deeper conceptual understanding. To foster even greater gender inclusivity, educators should design learning experiences that encourage collaborative inquiry, guided reflection, and equal participation in analytical discussions.

In summary, AI-assisted invention education provides a promising pedagogical model for nurturing creativity, curiosity, and metacognition among young learners. By combining artificial intelligence with human ingenuity, such programs can prepare students—regardless of gender—to engage meaningfully in inventive problem solving and to contribute to future technological and social innovation.

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Parental Self-Concept in Supporting SEN Students' Career Development: A Pilot Validation Study

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Abstract: *Students with special educational needs (SEN) often encounter barriers in preparing for meaningful employment, including limited access to career guidance and family-based support. Although parental involvement is recognized as an important facilitator of SEN students' career development, empirical understanding of how parents perceive their capacity to provide such support remains limited. The lack of validated instruments has further constrained research in this area. This pilot study addressed this gap by developing and validating the Parental Self-Concept Instrument (PSCI) for SEN Students' Career Support. Grounded in Career Construction Theory and the hierarchical, multidimensional self-concept model, the PSCI was designed to assess parents' self-perceptions regarding their support practices and career-related knowledge. Forty-five parents attending a public SEN-focused workshop completed an online survey. A two-stage psychometric procedure was used. Exploratory factor analysis yielded a two-factor structure after item refinement, representing Parent Self-Evaluation of Practice and Parent Self-Evaluation of Knowledge. The final 14 items accounted for 66.3% of the variance. Multidimensional Rasch analysis further supported the adequacy of the two-dimensional model, with all items demonstrating acceptable infit and outfit values. Concurrent validity was examined through correlations between the PSCI dimensions and parent-assessed career adaptability, which showed significant positive associations. Findings suggest that parental self-concept consists of distinct but related practice and knowledge components, each relevant to understanding parents' perceived role in supporting SEN students' career development. The PSCI offers an initial, evidence-informed tool for assessing parental self-concept in SEN career support and can guide future longitudinal research and the design of family-oriented support initiatives.*

Keywords: parents' self-concept, career support, career adaptability, students with SEN

1. Introduction

Students with special educational needs (SEN) encounter persistent barriers in preparing for meaningful employment, including restricted access to career guidance, limited vocational training opportunities, and social stigma (Carter et al., 2012; Lindsay, 2011). Family support—particularly parental involvement—is a well-established facilitator of SEN students' career development (Trainor, 2008). Although recent policies emphasize the importance of parental engagement (European Agency for Special Needs and Inclusive Education, 2017), empirical knowledge about how parents perceive their own capacity to provide such support remains limited. Emerging research suggests that parental self-concept meaningfully shapes parenting behaviour, with lower self-worth associated with psychologically controlling practices that may negatively affect child outcomes (Gittins et al., 2020). Despite its significance, validated instruments assessing parental self-concept within inclusive education and career support contexts remain scarce (Afolabi, 2014; Doren et al., 2012). This pilot study seeks to address this gap through the validation of the Parental Self-Concept Instrument (PSCI) for SEN Students' Career Support, using exploratory factor analysis and Rasch modeling to evaluate its dimensionality, reliability, and validity.

2. Theoretical Framework

The study integrates Career Construction Theory (CCT; Savickas, 2005) with the hierarchical, multidimensional self-concept model (Marsh & Shavelson, 1985). CCT posits that individuals construct career pathways through dynamic interactions with their environments, highlighting the critical role of family support. The hierarchical self-concept framework conceptualizes self-concept as both general and domain-specific, allowing the assessment of discrete dimensions relevant to parental career support. Drawing on these frameworks, the PSCI was designed to measure two core domains of parental self-concept: support practices and support knowledge. This theoretically grounded structure provides a basis for understanding how parents perceive their capability to assist SEN students in career development.

3. Methods

A two-stage psychometric validation design was used. First, exploratory factor analysis (EFA) examined the internal structure of the PSCI, identifying problematic items and establishing an initial factor solution. Second, multidimensional Rasch modeling, grounded in Item Response Theory (IRT), assessed item functioning and model fit. Rasch analysis supports the creation of linear, interpretable scales. Fit was evaluated using infit and outfit mean square (MNSQ) values between 0.5 and 1.5 (Linacre, 2002). All analyses were conducted using R (Version 4.4) and Jamovi (Version 2.6).

3.1. Participants and Procedure

Data was collected during a public workshop on supporting SEN students' career development. Parents voluntarily completed an online survey assessing their practices and perceived knowledge related to their child's career development. A total of 45 parents (96% were female) participated.

3.2. Parental Self-Concept Instrument (PSCI)

The PSCI consists of 18 items across three preliminary domains: ability development, interest development, and career value knowledge. Items were grounded in CCT (Savickas, 2005) and refined by a professional panel of SEN career-training teachers and special education scholars to ensure content validity. Sample items include: "I help my SEN child explore possible problems encountered at work and solutions" and "I help my SEN child understand the importance of job stability."

3.3. Concurrent Validity Measure

An adapted version of the Career Adaptability Scale (Maggiori et al., 2015) was included to assess concurrent validity, informed by research suggesting positive associations between parental support and children's career adaptability (Zhang et al., 2025). Person correlations were employed to test this relationship.

4. Results

4.1. Exploratory Factor Analysis

EFA revealed two primary factors following item refinement. Three items demonstrating cross-loadings (Item_10, Items 11 and Item_12) and one item with a low loading (Item_5) were removed. The final 14-item structure comprised (a) Parent Self-Evaluation of Practice (PSEF, 8 items) and (b) Parent Self-Evaluation of Knowledge (PSEK, 6 items), accounting for 66.3% of the variance.

4.2. Rasch Analysis

Rasch modeling confirmed that a two-dimensional model provided a better fit than a unidimensional model, as indicated by lower AIC, BIC, and CAIC values. All items demonstrated acceptable infit and outfit MNSQ values (0.5–1.5), supporting satisfactory item functioning and alignment with the intended constructs.

4.3. Correlation analysis

Pearson correlation analysis revealed that the two subdimensions of PSCI are moderately correlated with each other. Meanwhile, significant positive correlations were also found between PSCI and parent-assessed children's career adaptability (PA-CA).

5. Discussion

This pilot validation provides initial evidence supporting the Parental Self-Concept Instrument (PSCI) as a multidimensional measure aligned with Career Construction Theory (Savickas, 2005) and the hierarchical self-concept model (Marsh & Shavelson, 1985). The identification of two distinct yet related dimensions—support practices and support knowledge—reflects contemporary understandings of parental involvement, emphasizing both behaviour and knowledge. Correlation patterns indicated robust internal consistency and meaningful associations with parent-rated career adaptability across its four subcomponents. Stronger relationships with Control and Curiosity suggest that parents who perceive themselves as competent across both domains may better facilitate their child's adaptive career behaviours, consistent with CCT's emphasis on supportive contexts. Practically, these findings support the development of interventions and family workshops aimed at strengthening both the practical skills and career-related knowledge of parents supporting SEN youth.

6. Limitation

Limitations include the small sample size (predominantly female) and cross-sectional design. All participants were attending a specific workshop and were likely highly engaged with the SEN community compared to general parents. This restricts generalizability regarding parental self-concepts in this domain outside of supportive environments or contexts focused on SEN career development.

Future research should examine the PSCI longitudinally and across more diverse SEN families to establish broader generalizability. Practically, this study supports the development of interventions specifically designed to enhance parents'

confidence in their practical skills for supporting their SEN children's career transitions. Workshops that focus on hands-on strategies rather than just theoretical knowledge may be particularly effective.

Overall, the study provides preliminary support for the PSCI's structural validity and its relevance in advancing research on parental engagement in the career development of students with SEN.

Acknowledgements

We thank all the participants who joined this study. This study considered to be a preliminary validation study of an instrument designed to contribute to future research on parents' role in SEN students' career development.

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Psychological Capital Protects University Students from Anxiety and Depression: Coping as a Mediating Mechanism

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ABSTRACT

The study aims to examine the mediating effects of adaptive and maladaptive coping strategies among the university student population in the association between psychological capital (PsyCap) and depressive symptoms and anxiety using a two-wave prospective study design. Grounded in the Conservation of Resources theory, the present study proposes that PsyCap is negatively associated with depressive symptoms and anxiety through the mechanisms of enhanced adaptive coping strategies and reduced maladaptive coping strategies. 507 undergraduate students in Hong Kong were recruited for the study. A structured questionnaire, measuring PsyCap, adaptive and maladaptive coping strategies, depressive symptoms, and anxiety, was distributed at the start and end of the semester. A structural equation model was conducted to examine the proposed mediation model. Results revealed that PsyCap at T1 was negatively and indirectly associated with depressive symptoms at T2 and anxiety at T2 through reduced maladaptive coping strategies at T2. However, the mediating pathway through enhanced adaptive coping strategies at T2 was not significant. The present study demonstrates how PsyCap acts as a protective factor for university students in mitigating their everyday challenges. The findings highlight the role of PsyCap as a set of psychological and personal resources that reduces the use of maladaptive coping strategies in the academic setting, thereby alleviating students' depressive symptoms and anxiety.

KEYWORDS

Psychological capital, Coping strategies, Depressive symptoms, Anxiety, Psychological resource

Leveraging Jones' Five Meta-Strategies and the 4T Lenses in Generative AI-Facilitated Learning of the Theory of Constructed Emotion in a Mindful and Critical Way: An Autoethnography Study

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ABSTRACT

The integration of Generative Artificial Intelligence (GenAI) in education is rapidly transforming learning ecosystems, offering unprecedented opportunities for personalized instruction. There is a plethora of research on the operational efficiency of GenAI-assisted learning, overlooking critical digital literacies for deeper learning. This gap is particularly profound when learning complex, paradigm-shifting theories like Lisa Feldman Barrett's Theory of Constructed Emotion (TCE) (Barrett, 2017), which challenges deeply ingrained biological essentialist views of emotions. To address this research gap, this study adopts an autoethnographic methodology to explore how GenAI facilitates learning of TCE in a metacognitive and critical way by proposing a novel integrative framework that synergizes Jones's (2025) five strategies (Iterative testing, Critiquing output, Adversarial prompting, Strategic ambiguity, and Reverse engineering) with Lin & Chen's (2025) 4T Lenses (translanguaging, trans-semiotizing, transknowledging, and transculturing). Drawing from the first author's experience of teaching English in a higher vocational college, the human-AI interactions revolve around the application of TCM in the job interview context. Through this active process, the first author iteratively tested GenAI's model of emotion by introducing the stammering cues from interviewees, critiquing GenAI's output rooted in the classical view of emotion. Using adversarial prompts and strategic ambiguity, the first author found that GenAI tends to grasp prototypical features of emotion concepts, subsequently generating universalized answers. And then the reverse engineering technique turns a critical lens onto the researcher's own prompting strategies. The process shows that the leverage of the five strategies in GenAI-facilitated learning transforms participants from passive receivers of AI-generated content towards active, critical, and reflective AI collaborators and supervisors, indicating a significant meta-cognitive leap. In addition, Human-AI communication provides a dynamic site for practising transculturing, transknowledging, and translanguaging. Implications for critical AI pedagogy and practices are proposed.

KEYWORDS

AI-facilitated learning, critical AI literacies, going mindfully meta, 4T lenses, theory of constructed emotion

Identifying Important Predictors for Mental and Physical Health Among Secondary School Students

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ABSTRACT

Student health remains a significant global concern, attracting considerable research attention. While many studies have explored factors influencing student health, most have concentrated on a limited number of predictors or examined mental and physical health separately. This study adopts a holistic approach by investigating the relationships between nine distinct predictor dimensions, such as emotional and interpersonal dimensions, and both mental and physical health outcomes among students in Hong Kong and the Netherlands. Employing several machine learning methods and utilizing data from the 2022 PISA assessment, the results reveal that emotional and social capital factors (e.g., being bullied, social connection to parents, and sense of belonging) are vital for student health in both Hong Kong and the Netherlands. Moreover, environmental influences (feeling safe) appear to be more prominent in shaping student health in Hong Kong, whereas physical factors (body image) play a more critical role in the Netherlands. The models developed demonstrated better predictive performance with data from the Netherlands compared to Hong Kong. Additionally, the models made across different societies have worse performance than those made within the same cultural context. These findings underscore the importance of cultural differences in determining the key factors shaping student mental and physical health. Overall, the study suggests that interventions focusing on enhancing emotional and social capital may be especially effective in addressing mental and physical health challenges faced by students worldwide.

KEYWORDS

Mental health, Physical health, Machine learning, Secondary school students, PISA

What does "Well-being" mean? A systematic literature review on doctoral education

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ABSTRACT

The well-being of doctoral students is essential throughout their academic journey, influencing both their mental health and academic performance. In response to growing awareness of the psychological pressures, isolation, and academic burnout faced by doctoral students in recent years, researchers have begun to re-evaluate the central role of 'well-being' in doctoral education. Nevertheless, existing studies often fall short of providing systematic analyses and in-depth exploration of the dimensions of doctoral student well-being, the supportive factors that sustain it, and its impact on academic and personal outcomes. This study employs the PRISMA process to conduct a systematic literature review, identifying significant studies in the field of doctoral education and student well-being. It aims to address the following three key research questions: 1) what is doctoral students' wellbeing? 2) how is doctoral students' wellbeing supported? 3) what are the outcomes of doctoral students who are emotionally supported? Drawing from both empirical and non-empirical literature across five major databases, the study provides a comprehensive overview of the core elements shaping doctoral student well-being, the influencing factors, and the resulting outcomes. This research deepens understanding of doctoral student well-being and promotes the development of a more inclusive and human-centered doctoral education.

KEYWORDS

Doctoral education, Doctoral supervisory relationship, Well-being, Systematic literature review, Higher Education

Digital Transformation of Teaching and Learning: Institutional Strategies and Reflections from HKSYU

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ABSTRACT

This presentation outlines recent initiatives promoting the digital transformation of teaching and learning at Hong Kong Shue Yan University (HKSYU). Guided by our five-year strategic plan, Reinventing Liberal Arts Education for the Digital Era, and the forthcoming plan to further advance interdisciplinary education through digital innovation, HKSYU has launched a range of programmes and projects that foreground technology-enhanced learning. To prepare academic staff for emerging pedagogical demands, we have implemented a series of professional development initiatives, including teacher training workshops and digital resources on blended learning, gamification, and VR/AR, as well as teaching and student project awards that recognize innovative pedagogy and meaningful integration of digital technologies. The presentation will also discuss our institutional guidelines on generative AI, reflections on assessment redesign in the AI era, and evolving quality assurance mechanisms for AI-integrated teaching and learning. We argue that it is essential to uphold academic integrity while embracing the transformative potential of generative AI in higher education, and that AI offers a critical opportunity to reimagine assessment strategies for deeper and more authentic learning. The presentation will conclude by reflecting on the challenges and opportunities that digital transformation presents for a liberal-arts-centered university such as HKSYU, and how these insights can inform wider sectoral discussions on leading meaningful, ethical innovation in higher education.

KEYWORDS

teaching and learning development, GenAI, digital transformation, digital resources, assessment design

Transforming English Grammar Instruction in Vietnam: Evidence from Students'

Acquisition of English Non-null Objects

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Abstract: This study addressed the question of how the findings from Vietnamese students' acquisition of English non-null objects can inform the design of innovative pedagogical approaches to teaching English grammar in Vietnam. Grounded in the Full Transfer hypothesis, the investigation examined the difference between Vietnamese null-argument structures and English obligatory argument requirement by comparing, across English-medium Instruction (EMI) and Vietnamese-medium Instruction (VMI) programmes, tertiary students' accuracy on a Grammaticality Judgement/Correction Task. The findings revealed that despite excessive focus on explicit grammar with teacher-centred instruction in VMI settings, many students still encountered grammar issues whereas most EMI students outperformed them, presumably thanks to their intensive second language exposure. These results inform pedagogical transformation by highlighting the need for innovative form-focused interventions that specifically target transfer effects, especially between marked language systems (e.g., Vietnamese – English). Consequently, it is proposed that consciousness-raising activities and processing instruction are potentially effective approaches to help learners identify non-null objects and understand their obligatory nature in English structures, thereby minimising transfer effects. Such pedagogical approaches necessitate careful curriculum redesign, systematic implementation across educational levels, and enhanced teacher training programmes to effectively bridge the acquisition gaps and maximise grammatical competence in Vietnamese educational contexts.

Keywords: non-null objects, English grammar instruction, L1 transfer, pedagogy, innovation

1. Introduction

In Vietnam, English has become an obligatory subject at all educational levels, including tertiary level where it can serve as a distinct discipline or a subject as well (Hoang, 2010b). Particularly, at this level, students with exposure to English-medium instruction (EMI), “the use of the English language to teach academic subjects (other than English itself) in countries or jurisdictions where the first language of the majority of the population is not English” (Macaro et al., 2018, p. 37), acquired better linguistic skills (Tang et al., 2025), showed better results in objective tests (Nguyen, 2023) and have improved vocabulary (Nguyen & Dang, 2024). However, under EMI, certain linguistic components could stay stagnant since Nguyen and Dang (2024) reported that students' writing skills and grammatical use remained inadequate.

Several issues of teaching and learning English in Vietnam have been identified. Most notably, the mismatch between teaching and testing (Hoang, 2010b) leads to only explicit knowledge of grammar being tested, overlooking other aspects of proficiency like speaking or listening skills (Le et al., 2024). This was further amplified by the belief that language accuracy and confidence could be greatly enhanced through solid knowledge of grammar (Le et al., 2024). It could be due to such overfocus on teaching grammar that the effect of first language (L1) transfer has been quite visible as a learning issue for L1 Vietnamese learners of English.

In this study, whether adult learners may overcome deep-rooted L1 syntactic biases to acquire a second language (L2) parameter setting is the main question, leading to subsequent pedagogical implications. Provided that the richer and more realistic input in EMI might result in more understanding of English argument structure, this study proposed a contrastive view of how undergraduate students in EMI programmes, with long-term exposure to English and a variety of English contents, learn a particular type of English syntactic complements, namely non-null arguments, with their counterparts in VMI programmes, to whom English is usually taught in language courses in a more explicit manner (Nguyen & Dang, 2024).

Regarding non-null arguments, English typically requires overt arguments, while Vietnamese permits arguments (such as referential and personal pronouns) to be dropped, which is one of the starkest linguistic differences between the two languages (Cognola & Casalicchio, 2018; Dang, 2022; Huang & Barry, 2013; Radford, 2009; Shei & Li, 2022). (1) and (2) serve as examples of non-null arguments in English and null arguments in Vietnamese, respectively.

A: Bạn đã làm bài tập chưa?
you do homework yet?
'Have you done your homework yet?'
B: Ø làm Ø rồi.
Ø do Ø already
'(I) have done (it) already.'

A: Has Anna done her homework yet?
B: She has done it already.
C: *done it already.
D: *has done already.

In Vietnamese, arguments can be omitted with almost no restriction (Shei & Li, 2022) as shown in (1) where the null subject and object in B's response are co-indexed with 'you' and 'homework,' respectively, in A's question. Neither the subject

nor the object has to be overt, and the presence of the referential ‘*it*’ even causes unnaturalness to B’s responses due to discourse redundancy (Cognola & Casalicchio, 2018; Dang, 2022; Shei & Li, 2022). In English, by contrast, arguments must be overt as shown in C’s and D’s responses to A’s question in (2). Since the lexical verb ‘*do*’ is a two-place predicate that takes two obligatory arguments, the absence of referential pronouns ‘*she*’ and ‘*it*’ in C’s and D’s responses respectively causes the ungrammaticality of the sentences. As null/ non-null subjects have been investigated (Hseih, 2008; Kong, 2001), only null/ non-null objects were tested in this study. Thus, this study aims at answering the research question: *How can the findings from EMI and VMI students’ acquisition of English non-null objects inform the design of innovative pedagogical approaches to teaching English grammar?*

2. Theoretical Framework

The FT/FAH provides a principled generative grammar-based paradigm for comprehending how a learner’s L1 effects L2 learning. It was initially introduced by Schwartz and Sproue (1994, 1996) and further developed by others (e.g., Dekydtspotter et al., 2006; White, 1989, 1990). There are three main parts of the FT/FAH. The *Full Transfer* is the initial claim. The learner’s whole L1 grammar, including all functional categories, parameter settings, and syntactic structures, is projected onto the L2 starting state during the first stage of L2 learning (Schwartz & Sproue, 1996; Conradie, 2005). This phenomenon, often referred to as *absolute L1 influence*, is expected to manifest most prominently in low-proficiency learners. Due to the scope of this study, only the *Full Transfer* was utilised for data analysis.

3. Data Collection and Analysis Methods

3.1. Participants

Thirty-five (35) participants across various majors studying at universities in Hochiminh City were recruited and divided into two groups: EMI and VMI, all of whom speak Vietnamese as their first language and learned English as part of the national curriculum and were enrolling various majors (apart from English). Ideally, all participants should finish preparatory English language courses prior to entering major-specific programs (Prime Minister of Vietnam, 2012); therefore, only third- and fourth-year students were included. The Quick Placement Test (QPT, Version 2; UCLES, 2001) was used to evaluate their performance, and it was divided into three CEFR levels: lower-intermediate (≤ 39), upper-intermediate (40–49), and advanced (50–60). Their participation was voluntary, with informed consent obtained from all participants. Data analysis encompassed all categories and competency levels. Anonymity and confidentiality were maintained throughout.

3.2. Stimuli

In the investigation, a sentence structure with transitive verbs was used. Another syntactic rule of with/without a following prepositional phrase was also under consideration for stimuli generations, meaning that for each experimental item or control item, after the null object or the overt object position, a prepositional phrase was present or absent. There was four experimental sentence and four control sentences for each condition. Additionally, 10 fillers were included in the test sentences, balancing grammatical and non-grammatical ones, to prevent exaggerating phrase differences. ChatGPT (April 4, 2023, OpenAI, <https://chat.openai.com/chat>) was used to construct all of the filler items. A total of 26 test items were created by combining the 16 test sentences with 10 fillers. Additionally, a panel of experts evaluated the content validity of the GJCT using the Index of Item-Objective Congruence (IOC), developed by Rovinelli and Hambleton (1977), to measure the content validity of the test items.

3.3. Procedure

Each sentence was embedded into a PowerPoint presentation and presented visually. Participants were requested to complete the GJCT individually in an online platform. The researcher conducted the session live via video conference platforms (Zoom and Google Meet). The participants were instructed that each item contained only one or no grammatical error and their task had two components: (i) judge the sentence’s grammaticality by selecting *True* or *False*, and (ii) for each *True* response, no more additional steps were required, and for each *False* response, rewrite or give an alternative version using the correct form of the sentence. To minimise misunderstanding, all instructions were given in Vietnamese, the shared L1 of both the participants and the researchers.

The analysis for the GJCT focused on accuracy scores of experimental items only. Participants needed to (i) correctly judge the sentence as ungrammatical, and (ii) provide a correction that supplied an appropriate overt object in the null position. Therefore, corrections that did not address the missing argument were considered structurally unrelated, and thus awarded no points, even if the initial judgment had been correct. The mean score of each was computed for null-object items. To statistically compare performance between the EMI and VMI groups, independent-samples t-tests were conducted.

4. Findings and Discussion

4.1. Descriptive Evidence for EMI Advantage in GJCT

The statistical analysis examined 35 participants distributed across two instructional contexts, with 17 students receiving EMI and 18 under VMI. From the descriptive statistics, it appears that EMI students attained a higher mean performance ($M_{EMI} = 0.68$, $SD_{EMI} = 0.31$) in comparison with their VMI counterparts ($M_{VMI} = 0.54$, $SD_{VMI} = 0.32$). Both cohorts exhibited substantial variability in their scores, which suggests considerable individual differences within each instructional group.

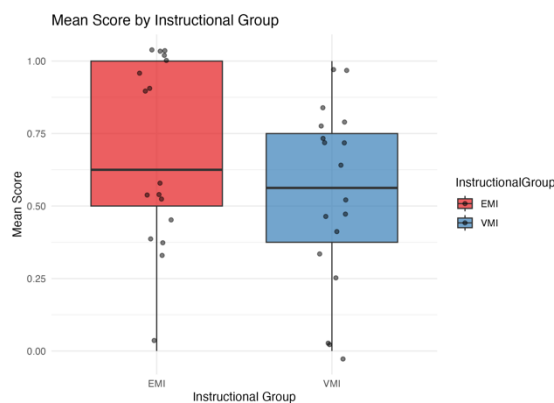


Figure 1. Mean Scores by Instructional Groups

The independent-samples t-test yielded results that deserve careful consideration. Despite the numerical advantage observed among EMI students, the statistical analysis revealed no significant difference between the groups, $t = 1.25$, $p = .219$, 95% CI [-0.08, 0.35]. This seems to indicate that instructional medium alone did not constitute a determining factor in the students' acquisition of English non-null objects, thus necessitating a more nuanced examination of other contributing variables for future reference.

4.2. Pedagogical Implications

From the aforementioned results, it appears that despite said excessive focus on grammar with teacher-centred instruction at all levels, many of the VMI students still encountered grammar issues, whereas most EMI students outperformed them, presumably thanks to immersive English instruction in their majors. This necessitates more innovative pedagogical and/or teaching methods that facilitate learners' acquisition and production of English grammar. One of the treatments that can be considered is consciousness-raising (C-R) and noticing (Fotos, 1993). As "noticing was operationali[s]ed by embedding the target structures in [...]" diverse activities that could direct learners' attention towards the function(s) of the grammar point(s) (Fotos, 1993, p. 396), this should turn *input* ("perceived information") into *intake* (noticed information, "critical to subsequent processing of the forms") (Fotos, 1993, p. 387). For example, it is necessary to enable learners to identify non-null objects in English and figure out that these elements are obligatory in a plethora of structures, thus preventing negative transfer from emerging.

Another form-focussed pedagogical intervention worth mentioning is processing instruction (PI), which also serves to evade L1 transfer. While C-R and noticing activities should start with semantic concepts (Garden, 1999), PI focuses more on grammatical forms in its framework (Lee & Benati, 2023). Unlike traditional grammar drills such as *fill in the blanks*, it is expected through the PI framework that learners can "adopt [...] optimal processing strategies" (Lee & Benati, 2023, p. 1). VanPatten and Cadierno's (1993) study on object pronouns and word order in L2 Spanish showed that learners made "significant gains in both comprehension and production" (p. 225). In the case of Vietnamese context, for example, the explicit instruction about non-null objects in English can be given to learners in class as well as opportunities for them to 'rewire' the rule(s) in their brains, thereby solving the processing problem(s) they might (have) face(d).

As can be seen, the findings have partly evidenced the FT hypothesis as well as demand a radical transformation in grammar instruction in Vietnam. This does not mean abandoning traditional or communicative approaches to teaching grammar but rather elucidates some of the learners' acquisition patterns and gaps, i.e., non-null objects in English in this study. Innovative pedagogical approaches are thus called for to bridge the gap(s), especially at upper- and secondary levels, in which some examples such as C-R and noticing and PI are reported to be quite effective. To consolidate the effectiveness, course syllabus design and implementation also need to be carefully (re-)considered since syllabi guide the sequence of units and might partly influence how instruction is carried out in the classroom across levels. Teacher training and professional development for teachers should also emphasise the innovation of teaching methods and/or pedagogical approaches for the effect of L1 transfer to be minimised and learners' acquisition of grammar to be maximised.

5. Conclusion

The current investigation has sought to determine how Vietnamese tertiary students' acquisition of English non-null objects might inform the transformation of grammar instruction in Vietnam. Through the application of the GJCT framed under the FT/FAH, this study examined the degree to which instructional media influenced learners' ability to overcome the persistent L1-L2 conflict between Vietnamese null-argument structures and English obligatory argument requirements. Despite numerically significant advantages for EMI students, intensive L2 exposure, characteristic of EMI environments, did not itself constitute a sufficient mechanism for overriding a deeply entrenched L1-influenced parameters. The findings effectively necessitate a call for explicit, form-focused pedagogical approaches such as C-R and noticing, which systematically directs learners' attention to the structural differences between Vietnamese and English, and PI, which aims to retrain learners' cognitive parsing mechanisms.

Of consideration, the study acknowledges certain limitations. The modest sample size may have constrained statistical power to detect smaller effect sizes between instructional groups. Furthermore, the cross-sectional design, while useful for comparative analyses, precludes tracking individual developmental trajectories, allowing only inferences rather than direct evidence of developmental pathways. Longitudinal research tracking learner cohorts across multiple years would therefore map specific developmental stages in non-null object (and other structures) acquisition more precisely. Moreover, experimental intervention studies employing pre-test/post-test designs with targeted C-R and noticing or PI treatments could provide more direct evidence for the proposed pedagogical innovations.

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生成式 AI 對香港大專學生自主學習能力的影響：一項個案研究

The Impact of Generative AI on Self-regulated Learning Abilities

of Hong Kong Tertiary Students: A Case Study

易瑩瑩

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摘要

近年來，AI 的普及為教育領域帶來新的機遇和挑戰。其在提升學生學習動機和效率的同時，也有機會削弱學生的獨立思考和批判性思維能力。這種變革對學生的自主學習能力提出更高要求。在此背景下，香港大專學生中文寫作教學面臨雙重挑戰，一方面需要回應技術發展對學習模式的影響，另一方面更要達成培養自主學習者的重要教育目標，培養學生的獨立思考與批判性分析能力。本研究以香港大專院校中文寫作課堂為研究場景，探索通過生成式 AI 培養自主學習者的有效途徑。本研究結合質性和量化的研究方法，探究生成式 AI 對香港大專學生自主學習能力的影響。研究對象包括 45 名香港大專院校一年級學生，研究搜集的量化資料包括，通過前後測問卷，收集學生在使用生成式 AI 輔助應用文寫作前後，其自主學習能力的變化；質性資料採取目的性抽樣，選取中文應用文寫作能力高、中、低水平的學生各兩名進行個人訪談，以深入理解生成式 AI 對其中文寫作和自主學習能力的影響。研究成果有助於中文教師加深對香港大專學生中文寫作現狀的瞭解，反思並優化現有的寫作教學實踐，從而提升寫作教學成效，並進一步促進學生的自主學習能力，具有重要實踐意義。

关键词

生成式 AI；自主學習能力；香港大專學生；中文寫作



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