EASE 2026

29 - 30 May
Hong Kong

STEAM Education in the Age of Artificial Intelligence

Organisers

香港教育大學 The Education University of Hong Kong
E·A·S·E East-Asian Association for Science Education
CELT Centre for Excellence in Learning and Teaching 卓越教學發展中心
科學與環境學系 Department of Science and Environmental Studies

Co-organisers

粵港澳高校中小学 STEAM教育联盟
CREST Center for Robotics Education & Science Teaching

Contents

Welcome Message

Prof. May May Hung Cheng
鄭美紅教授

Prof. Keith Wing Kei Ho
何詠基教授

On behalf of the Local Organizing Committee of 2026 EASE conference, it is our pleasure to welcome you all to the International Conference on "STEAM Education in the Age of Artificial Intelligence". STEAM education plays a crucial role in shaping a sustainable future for our world. By bringing together leading experts, early-career researchers, and passionate educators from East Asia societies, we aim to foster interdisciplinary dialogue, share best practices, and explore innovative approaches to STEAM education that can positively impact the lives of students and communities.

In recent years, East Asia societies have witnessed a new wave of STEAM curriculum reforms, as educators and policymakers work to address the challenges of the increasingly uncertain 21st century. As a prominent event in the field of STEAM education research for East Asia learners, this conference aims to provide a platform for East Asia STEAM education scholars from around the world to share their insights and inform the current tide of STEAM education reform. Additionally, the academic community will have the opportunity to identify novel research questions and generate new theoretical frameworks by engaging with the perspectives of frontline STEAM education practitioners.

Over the course of the three-day conference, we have curated an exciting and diverse lineup of events to inspire, challenge, and empower you. Our program features a series of captivating keynote addresses and invited speeches delivered by renowned experts, providing deep insights into the latest trends and innovations shaping the field of STEAM education. Complementing the keynotes and invited speeches, we have organized engaging panel discussions that will explore complex issues from multiple perspectives, as well as paper presentation sessions highlighting cutting-edge research. Additionally, teacher forums will offer hands-on opportunities for skill development and collaborative problem-solving. Throughout these sessions, you will engage in thought-provoking discussions, exchange ideas, and build lasting connections with your global peers.

I would like to express my sincere gratitude to EASE, the colleagues of Local Organizing Committee, the co-organizers, project staff of EDUHK, supportive student helpers, and all the participants for their dedication and contributions to this important event. I am confident that this conference will be a resounding success, and I look forward to the rich discussions and collaborative opportunities that will emerge.

Thank you all for being here, and we wish you a productive and enjoyable conference.
Sincerely,

May CHENG May Hung, The Education University of Hong Kong
Keith Wing Kei Ho, SES, The Education University of Hong Kong

Centre for Excellence in Learning and Teaching
The Education University of Hong Kong

Centre for Excellence in Teaching Development, under The Academy for Educational Development and Innovation (AEDI) at The Education University of Hong Kong (EdUHK)

The mission of the Centre is to support schools, promote teacher professional development, and advocate effective classroom teaching, thereby enhancing the quality of teaching and learning and striving for teaching excellence. The Centre aspires to become a leading teaching development centre in Hong Kong and the Asia-Pacific region, cultivating outstanding teachers and developing exemplary classroom practices.

The Centre is dedicated to three core areas of development: promoting teacher professional development, establishing professional learning communities for teachers, and enhancing teaching effectiveness to achieve excellence. It aims to develop quality teaching theories, design effective instructional methods, and disseminate outstanding teaching outcomes, thereby improving student learning effectiveness. The Centre strengthens collaboration with local schools, educational organisations, and overseas institutions to promote specialised teaching research.

To fulfil its mission, the Centre organises teacher professional development programmes, seminars, and workshops; provides school-based consultancy and support services to enhance teaching effectiveness, ensuring that students of diverse abilities receive appropriate instruction and support; facilitates teaching observation and sharing activities; builds a platform for teacher exchange; establishes a high-quality teaching resource repository; and publishes papers and books to summarise and promote the results of teaching research.

As an academic unit with an international vision, the Centre actively engages in cross-regional research and teaching collaboration. It is committed not only to curriculum development and improvement but also to fostering exchanges in teaching and assessment across different educational perspectives. The Centre provides students with diverse subject learning experiences and supports schools and institutions in teacher professional development at local, regional, and international levels.

The Centre firmly believes that through close cooperation and partnerships with the education sector, it can serve society and contribute to the development and improvement of educational policies and practices.

Department of Science and Environmental Studies
The Education University of Hong Kong

The Department of Science and Environmental Studies (SES) is a professional academic unit at The Education University of Hong Kong that promotes science and environmental education and research. It offers programmes related to science and environmental education subjects for primary and secondary schools. The mission of the Department is to promote and support the development of teacher education, provide quality science education and teacher training, and strive to cultivate teachers who become self-reflective education practitioners with the ability to deliver high-quality teaching in classrooms, as well as the knowledge, skills, and attitudes necessary to support the sustainable development of schools, thereby becoming education professionals in the fields of science and STEAM. Furthermore, the Department places strong emphasis on developing research and scholarly activities related to science and environmental education. It provides various opportunities for students to participate in scientific research oriented towards environmental sustainability. Through the interaction and synergy between research and teaching activities, students and staff, together with experienced scientists and educators in the Department, are committed to teaching, research, and knowledge transfer, achieving excellence in their respective fields.

In terms of academic programmes, the Department of Science and Environmental Studies offers a diverse and comprehensive range of undergraduate and postgraduate programmes, including the newly launched undergraduate programme, the Bachelor of Science (Honours) in Integrated Environmental Management and Bachelor of Education (Honours) (Science) (Concurrent Double Degree). This programme covers two major areas of study: environmental management and primary/secondary science education. It provides interdisciplinary training, with the science education component covering educational theories and skills and offering practicum experiences to cultivate professional teachers capable of teaching science curricula at various educational stages. The environmental management component includes knowledge of science, computation, socio-economics, and regulations, as well as an environmental management internship. Through interdisciplinary learning, students acquire sound educational literacy while finding connections between education and environmental science, thereby contributing to the sustainable development of society. Additionally, the Department offers the Postgraduate Diploma in Education (PGDE) programme to help science graduates transition smoothly into becoming science teachers in primary and secondary schools.

In research, the Department's academic staff have extensive research interests covering fields such as physics, chemistry, biology, environmental studies, science education, and environmental education. They are committed to translating research outcomes into practical teaching materials, enriching the curricula of universities, secondary schools, and primary schools, and developing innovative teaching methods and activities. The Department offers various postgraduate programmes, including research postgraduate and taught postgraduate programmes, encompassing Doctor of Philosophy (PhD), Master of Philosophy (MPhil), Doctor of Education (EdD), Master of Education (MEd), Master of Arts in Sustainable Development (MA(SD)), and Master of Arts in STEM Education (MA(STEM)).

With a global orientation, the Department actively collaborates with universities and institutions both locally and internationally to broaden students' learning experiences. Through overseas exchanges, field trips, and other collaborative activities, the Department promotes the internationalisation of its curricula and further enhances the quality of teaching and research.

Time	Programme Overview : *29 May, 2026*
08:15-09:25	Registration
09:30-10:00	Opening Ceremony [N-1/F-09]
10:00-11:00	Keynote Address 1: Thinking With AI: What Should Science Education Cultivate in the Age of Artificial Intelligence? [N-1/F-09] | **Jennifer Adams**
11:00-11:30	Morning Tea Break
11:30-12:15	Invited Speech 1: Artificial Intelligence in Interdisciplinary Education [D2-LP-12] **Zehui ZHAN**
	• Parallel Session 1.1 Generative AI as Teaching & Assessment Tool [B4-LP-08]
	• Parallel Session 2.1 Scientific Literacy & 5G/STEAM Curriculum [D2-LP-07]
	• Parallel Session 3.1 Integrating Traditional Culture & Local Knowledge [D2-LP-13]
	• Parallel Session 4.1 Student Cognitive Processes & Personal Characteristics [D2-LP-14]
	• Parallel Session 5.1 Higher-Order & Systems Thinking [D2-LP-10]
	Greater Bay Area Science Education Forum 1 [D1-LP-08] (Chinese)
12:15-13:30	Lunch
	EASE Executive Member Meeting [D2-LP-12]
13:30-14:30	Keynote Address 2: Consequential STEM Teacher Education in a Time of Change: The Potential and Promise of Newly Hired Teachers [D1-LP-03] **Julie A Luft**
14:30-15:30	Keynote Address 3: Focus on the Effective Cultivation of Innovative Talents to Achieve High-Quality Development of STAEM Education [D1-LP-03] **Weiping HU**
15:30-16:00	Afternoon Tea Break
16:00-16:45	Invited Speech 2: Beyond "Knowing and Doing" in Science Education: Reclaiming Scientific Inquiry as a Human Enterprise from the Perspective of Japanese STEAM Education [D1-LP-03] | **Ryugo Oshima**
	• Parallel Session 1.2 AI-assisted Text Analysis & Argumentation Assessment [B4-LP-08]
	• Parallel Session 2.2 Science/STEM Identity [D2-LP-07]
	• Parallel Session 3.2 Education for Sustainable Development & SSI [D2-LP-13]
	• Parallel Session 4.2 Science Conceptual Understanding & Misconceptions [D2-LP-14]
	Greater Bay Area Science Education Forum 2 [D1-LP-08] (Chinese)
	Greater Bay Area Science Education Forum 3 [D2-LP-10] (Chinese)

Time	Programme Overview : *30 May, 2026*
09:00-10:00	Keynote Address 4: STEAM Education in the Age of AI: A Human Capabilities Approach [D2-LP-12] | **James Davis**
10:00-11:00	Invited Speech 3: Building a Sustainable STEAM Education Ecosystem in Elementary Schools of Rural Southern Taiwan: The "Three Teachers + C" Co-Learning Model [D1-LP-07] | **Sheau-Wen Lin**
	• Parallel Session 1.3 AI Educational Platforms & Self-Directed Learning [D2-LP-08]
	• Parallel Session 2.3 Creative Thinking & Problem Solving [D2-LP-10]
	• Parallel Session 3.3 STEAM Curriculum Design & Implementation [D2-LP-13]
	• Parallel Session 4.3 Attitude towards Science [D2-LP-14]
	The 2nd Council Meeting of the 1st Session of the Guangdong-Hong Kong-Macao Alliance for Science Education [D2-LP-12]
	Greater Bay Area Science Education Forum 4 Cum the Conference of the Alliance for Improving Scientific Literacy [D2-LP-03] (Chinese, Online)
11:00-11:30	Morning Tea Break
11:30-12:15	Invited Speech 4: Improving Science Literacy through Local Wisdom-Based Citizen Science in Indonesia [D2-LP-12] | **Hadi Suwono**
	• Parallel Session 1.4 AI & AR Scaffolding for STEM Design [D2-LP-08]
	• Parallel Session 2.4 Problem solving & Design in STEM education [D2-LP-10]
	• Parallel Session 3.4 Inquiry-Based & Project-Based Learning [D2-LP-13]
	• Parallel Session 4.4 Science Process Skills & Communication [D2-LP-14]
	Greater Bay Area Science Education Forum 5 [D1-LP-08] (Chinese)
	Greater Bay Area Science Education Forum 6 Cum the Conference of the Alliance for Improving Scientific Literacy [D2-LP-03] (Chinese, Online)
12:15-13:30	Lunch
13:30-14:30	Keynote Address 5: Promoting STEM Literacy in K-12 Science Education [D2-LP-12] **Xiufeng LIU**
	Greater Bay Area Science Education Forum 7 [D1-LP-08] (Chinese)
14:30-15:30	Invited Speech 5: The Effect of Teachers' Use of Artificial Intelligence for Designing Science Learning on Students' Scientific Literacy [D2-LP-12] | Chanyah Dahsah
	• Parallel Session 1.5 Student Epistemic Interaction with AI [D2-LP-08]
	• Parallel Session 2.5 Interdisciplinary Competence & STEM Literacy [D2-LP-10]
	• Parallel Session 3.5 Textbook & Material Content Analysis [D2-LP-13]
	• Parallel Session 4.5 Teacher Design Capacity & Planning Tools [D2-LP-14]
	Greater Bay Area Science Education Forum 8 [D1-LP-08] (Chinese)

15:30-16:00	Afternoon Tea Break
	General Assembly of EASE Members [D2-LP-12]
	Greater Bay Area Science Education Forum 9 [D1-LP-08] (Chinese)

16:00-17:00	• Parallel Session 1.6 Technology Integration in Teacher Education [D2-LP-08]
	• Parallel Session 2.6 Career Expectation & After-school STEM Activities [D2-LP-10]
	• Parallel Session 3.6 Preservice Teacher Cognition & Professional Identity [D2-LP-13]
	• Parallel Session 4.6 Assessment Methods & Tool Development [D2-LP-14]
	Greater Bay Area Science Education Forum 10 [D1-LP-08] (Chinese)

17:00-17:30	• Parallel Session 1.7 Generative AI-Assisted Assessment of Scientific Literacy [D2-LP-08]
	• Parallel Session 2.7 Review of Emerging Issues in Science Education [D2-LP-10]
	• Parallel Session 3.7 Teacher Beliefs, Orientation & Reflection [D2-LP-13]
	• Parallel Session 4.7 Teacher Professional Development Models & Pathways [D2-LP-14]
	Greater Bay Area Science Education Forum 11 [D1-LP-08] (Chinese)

ZOOM Meeting Link	
Keynote Address 1-5, Invited Speech 1-5	ZOOM Link 1
Parallel Session 1 (1. 1-1.7)	ZOOM Link 2
Parallel Session 2 (2.1-2.7)	ZOOM Link 3
Parallel Session 3 (3.1-3.7)	ZOOM Link 4
Parallel Session 4 (4.1-4.7)	ZOOM Link 5
Parallel Session 5 (5.1)	ZOOM Link 6

Keynote Address

Thinking With AI: What Should Science Education Cultivate in the Age of Artificial Intelligence?

Jennifer Adams

Faculty of Science, Department of Chemistry
University of Calgary

Professor Jennifer D. Adams is a Tier 2 Canada Research Chair of Creativity, Equity, and STEM at The University of Calgary in Faculty of Science. She is also the immediate past president of the National Association of Research in Science Teaching (NARST). She is the PI of the Creativity, Equity and STEM Lab where she leads her team in research on equity in STEM teaching and learning environments with an emphasis on identity-affirming, anti-deficit, desiring, and justice-oriented approaches. Dr. Adams has expertise in STEMM learning across contexts, including museums. She recently authored, "Informal Science Education and Teacher Learning" with Peter Lang Press about her research on learning to teaching with museums and other science-rich cultural institutions. She is in leadership on several Canadian national projects including "Securing Black Futures" which seeks to increase the visibility and support the flourishing of Black students in STEM and the Canadian Black Scientists Network where she is the PI of the STEM Beyond Borders initiative that examines Black in STEMM equity-oriented research, policy and practice in Canada and the United States. Her prior appointments include Brooklyn College and The Graduate Center, City University of New York, the American Museum of Natural History, New York, and The New York City Department of Education, where she taught high school biology and Earth science.

Abstract

Time 10:00-11:00 29 May, 2026
Location [N-1/F-09]

As artificial intelligence (AI) becomes increasingly integrated into education systems worldwide, science educators are being asked to reconsider not only how students learn, but what it means to think, know, and understand in an AI-rich world. While AI offers powerful possibilities for personalization and access to information, it also raises important pedagogical and ethical questions about the role of human intelligence (HI) in science learning. This keynote explores how AI is reshaping foundational assumptions in science education, including the nature of knowledge, the purpose of assessment, and the role of the learner. Drawing on justice-oriented and community-centered approaches to science education, the talk invites participants to consider how AI might support, not replace, core scientific practices such as sense-making, questioning, and ethical reasoning. The keynote also introduces a critical perspective on the presumed neutrality of technology, suggesting that AI systems reflect particular assumptions about knowledge and intelligence. This raises important questions about how AI is interpreted and used across different educational and cultural contexts. Ultimately, the talk invites educators to move beyond viewing AI as a tool for efficiency, and toward cultivating forms of human intelligence that emphasize curiosity, creativity, responsibility, and relational understanding in science education.

Keynote Address

Consequential STEM Teacher Education in a Time of Change: The Potential and Promise of Newly Hired Teachers

Julie A Luft

Department of Mathematics, Science and Social Studies Education
University of Georgia

Julie A. Luft, is a University of Georgia Distinguished Research Professor, and the Athletic Association Professor of Science and Mathematics Education, in the Mary Frances Early College of Education in Athens, Georgia, USA. She is a former science teacher and is still in classrooms today -working with teachers. She has published and presented her work nationally and internationally. In the field of science education, she has received numerous awards for her teaching, research, and leadership. She is a fellow of the National Science Teaching Association, American Association for the Advancement of Science, and American Education Research Association. In 2024, she was honored with the Distinguished Contributions to Research Award by the National Association of Research in Science Teaching. She is currently the Education Section Chair of the American Association for the Advancement of Science.

Abstract

Time 13:30-14:30 29 May, 2026
Location [D1-LP-03]

STEM teacher educators and teachers are navigating a time of significant change. New pathways are emerging to prepare teachers, AI is becoming increasingly ubiquitous in classrooms, and many educators lack the instructional supports they need to succeed. At the same time, the need for a STEM-literate society has never been greater. To navigate these shifting conditions, we must pay close attention to key indicators that reflect the state of our work. Newly hired teachers are one such indicator we have overlooked. By partnering with, observing, and learning from these educators, we can draw on past experiences to better plan for the future. Through deliberate and purposeful work, we can chart a path that strengthens and sustains both our STEM teachers and the broader field of STEM education.

Keynote Address

Focus on the Effective Cultivation of Innovative Talents to Achieve High-Quality Development of STAEM Education

Weiping Hu

MOE Key Laboratory of Modern Teaching Technology
Shaanxi Normal University

- lDirector of the Key Laboratory of Modern Teaching Technology Ministry of Education;
- lLead Revisor of the National Compulsory Education Science Curriculum Standards;
- lLead Revisor of the National High School Physics Curriculum Standards;
- lPresident of the Science Education Branch of the Chinese Society of Education;
- lChairman of the Global Chinese Society of Science Education Research;
- lExecutive Committee Member and Fellow of the International Society for Creativity and Innovation Research (ISSCI);
- lEditorial Board Member of peer-reviewed journals including Journal of Creative Behavior, Creativity Research Journal, and Gifted Education International.

Professor Hu has served as the Principal Investigator for the Major Project of the National Social Science Fund of China (Education Section): Research on Constructing the Science Education System for Primary and Secondary Schools. He has also led over 60 other national, provincial, and ministerial research projects. He has published more than 300 papers in core academic journals both domestically and internationally, including over 100 indexed in SSCI. He has received 31 national, provincial, and ministerial awards.

Abstract

Time 14:30-15:30 29 May, 2026

Location [D1-LP-03]

This presentation analyzed international STEM education experience and China's current situation in STEM education, proposes a framework for high-quality STEM education centered on cultivating innovative talents. Based on an in-depth analysis of the objectives, content, processes, and assessment of STEM education, we proposed a STEM ecosystem model named "three driving forces, three dimensions". Three driving forces include Objective, content and approach. Three dimensions include element, educational stages and stakeholders.

Core arguments include:

- Objectives: The objective of STEM education should focus on cultivating innovative talents. Developing four-dimensional talent traits is developed. It include knowledge breadth/depth, intrinsic motivation, innovative personality (curiosity/resilience), and high-order thinking.
- Content: Horizontal integration of science, technology, engineering, and humanities; vertical alignment across developmental stages (early explorationprofessional innovation); and infusion of cutting-edge scientific advances.
- Elements: It include policy, faculty, resources, curriculum, evaluation and research. High-quality STEM education should ensure coordinated, high-quality elements
- Educational Stages: Ensure progressive articulation across all stages(from primary school to university.
- Stakeholders : Strengthen collaborative education among eight entities (governments, schools, enterprises, etc.) via coordination, incentive, and integration mechanisms.

Keynote Address

STEAM Education in the Age of AI: A Human Capabilities Approach

James Davis

Faculty of Creative Industries, Education & Social Justice, School of Education
Queensland University of Technology

Dr James Davis is an Associate Professor in science education at the Queensland University of Technology, Brisbane Australia. James's research addresses concepts, practices, and policy connections associated with human capability development through science education across K-12, vocational and higher education contexts. He has an interest in complexity thinking, and capabilities that deal with risk for promoting antifragility in people and learning systems. James connects cross-disciplinary perspectives including foundational capabilities related to emotions, values and practical reasoning, as well as entrepreneurial capabilities and capabilities for self-determined learning. Currently James is Co-Editor-in-Chief for the Springer-ASERA journal, Research in Science Education (RISE), and an Editorial Board member for Emotions and Society published by Bristol University Press.

Abstract

Time 9:00-10:00 30 May, 2026
Location [D2-LP-12]

Artificial Intelligence (AI) is a disruptor to learning and teaching presenting possibilities for new directions in STEAM education. These new directions may leverage STEAM' s cross-disciplinary ways of thinking, and the careful rebalancing in educational contexts: A rebalancing between the need for canonical disciplinary knowledge, the need for process skills and the need for enhanced human capabilities. In many ways, AI has the potential to promote STEAM Education across complex, uncertain and divergent life-long learning progressions by reshaping how learners develop new capabilities for personal growth in an evolving AI-driven world.

Today I present some provocations on the importance of being human in the age of AI. Specifically, I will start with the nature of human subjectivity, the interplay between affect, emotions, cognitions and values, and the ways in which empirically driven lived experiences are at the heart of human learning and being human. I propose that human subjectivity is the foundation for STEAM driven empirical knowledge and continues to be the pathway for authentic and meaningful learning experiences that may connect with and use AI, without learners and educators being subsumed by AI.

In STEAM Education, connecting with AI typically means using AI as a resource for collecting and synthesizing information and knowledge. Such connectivity requires human input through evaluation, judgment, some level of canonical disciplinary knowledge, and a range of institutional and individual capabilities. At an institutional level I propose that STEAM Education providers ought to be striving towards collective capabilities associated with antifragility. Antifragility is a property of complex systems that enable learning, growth and prosperity under conditions of disorder and uncertainty, such as those created by AI. At an individual level I identify some of the foundational human capabilities underpinning development economics and sustainability. I then connect these to educational contexts through capabilities for self-determined learning and capabilities for cross-disciplinary entrepreneurial learning through social and cultural value creation for self and others.

I conclude that a human capabilities approach to STEAM Education in the age of AI should feature institutional and organisational capabilities to empower learners and educators to operate in conditions of disorder and uncertainty. Such empowerment means an emphasis on individual human capability development that will promote attributes for exercising judgment and practical reasoning while engaging with AI as a learning resource with its' inherent limitations of cultural and commercial biases that learners and educators must negotiate.

Keynote Address

Promoting STEM Literacy in K-12 Science Education

Xiufeng LIU

Faculty of Education
University of Macau

Dr. Xiufeng Liu is a Chair Professor of STEM Education and Director of Educational Testing and Assessment Research Centre in the Faculty of Education at the University of Macau. Before joining University of Macau, he was a SUNY Distinguished Professor of Science Education at University at Buffalo, State University of New York. He conducts research in measurement and evaluation in STEM education, particularly on student conceptual understanding of cross-cutting concepts (e.g., matter and energy) and student and teacher STEM identity. He has published over 150 refereed works, including 14 books and close to 100 refereed journal articles. Prof. Liu is a Fellow of the American Association for the Advancement of Science (AAAS, 2020) and American Educational Research Association (AERA, 2026).

Abstract

Time 13:30-14:30 30 May, 2026
Location [D2-LP-12]

Countries around the world are promoting STEM education in K-12 school subjects including science. Although there is an emerging consensus on the conception of STEM education on integrated teaching and learning of STEM, there is less agreement on the objectives of STEM education. We propose STEM literacy be the organizing theme for STEM education objectives. STEM literacy consists of three dimensions of competences: interdisciplinary problem-solving, STEM identity, and understanding the nature of STEM. STEM literacy builds on science and other disciplinary literacies; it further develops students' collective capacity of systems thinking in solving complex problems. Finally, STEM literacy must be inclusive and equitable. We propose a research agenda in STEM literacy for K-12 STEM education.

Invited Speech

Artificial Intelligence in Interdisciplinary Education

Zehui ZHAN

School of Information Technology in Education
South China Normal University

Zhan Zehui is a Professor and Doctoral Supervisor at South China Normal University (SCNU), recognized as a Young Pearl River Scholar and Hong Kong Scholar. She serves as Deputy Director of the Innovative Talent Cultivation Research Center (SCNU), Vice Director of the Guangdong-Hong Kong-Macao University STEM Education Alliance, and Deputy Director of the Guangdong Provincial Key Lab of AI and Smart Education. Her research focuses on interdisciplinary & innovative education, and AI & smart education. She has published six academic monographs, over ten textbooks, and more than 100 papers. Her honors include the National Excellent Doctoral Dissertation Nomination, Fok Ying Tung Young Teacher Award, MOE Humanities & Social Sciences Young Scholar Award, CNKI Top 1% Highly Cited Scholar, Elsevier China Highly Cited Scholar, and World's Top 2% Scientist (2025).

Abstract

Time 11:30-12:15 29 May, 2026
Location [D2-LP-12]

This keynote addresses the integration of artificial intelligence into interdisciplinary learning and STEM education. The presentation is structured in three parts. First, the key frameworks for STEM and interdisciplinary teaching will be introduced, including the C-POTE model and the C-STEAM approach. Second, the definition of AI and how it can be appropriately used in educational settings will be clarified , discussing both its affordances and boundaries to avoid overreliance or misuse. Third, some empirical studies and classroom/research-practice cases demonstrating how AI empowers interdisciplinary education will be presented, including teacher collaboration and data-driven instructional innovations. Drawing on our team' s recent work, this talk aims to provide a balanced, evidence-based perspective on leveraging AI to enhance authentic interdisciplinary learning.

Invited Speech

Beyond “Knowing and Doing” in Science Education: Reclaiming Scientific Inquiry as a Human Enterprise from the Perspective of Japanese STEAM Education

Ryugo Oshima

Faculty of Education
Chiba University, Japan

Ryugo Oshima is an Assistant Professor at the Graduate School of Education, Chiba University, Japan, specializing in Science Education. His research focuses on realizing "deeper learning" within the Japanese science curriculum, specifically investigating the psychological and pedagogical processes of inquiry-based learning. He examines how students can maintain their own sense of ownership and curiosity throughout scientific practices.

Beyond theoretical frameworks, he is dedicated to developing practical instructional models for inquiry-based activities that can be seamlessly integrated into everyday classroom settings. His work also involves evaluating the educational effectiveness of these models in fostering students' critical thinking and problem-solving skills. Through his research, he aims to bridge the gap between educational theory and school practice, supporting teachers in creating more engaging and cognitively demanding science learning environments for the next generation.

Abstract

Time 16:00-16:45 29 May, 2026
Location [D1-LP-03]

In the current landscape of Japanese science education, “inquiry” is often framed as a structured process where students follow carefully designed procedures to reach predetermined “correct” answers. While this approach ensures that students “know” scientific concepts and can “do” specific process skills, it often strips inquiry of its most vital element: the human dimension. As Japan transitions toward integrated STEAM education, particularly at the secondary school level, there is a critical need to re-examine the nature of scientific inquiry. This presentation argues for a shift beyond the mastery of process skills alone toward an inquiry model that emphasizes agency, decision-making, and the emotional journey of the learner. Drawing on recent observations of Japanese classroom practices, I highlight a paradox: while students find satisfaction in following teacher-led experiments, they are rarely granted the freedom to navigate the uncertainties inherent in authentic science. To bridge this gap, I propose a pedagogical approach that integrates “human elements” —such as the struggle, intuition, and creativity of scientists—into the curriculum. This involves allowing students to make autonomous decisions regarding experimental validity and reliability within certain boundaries, moving away from a “fail-proof” mindset. By experiencing the “human drama” behind scientific discoveries (e.g., the development of the periodic table), students engage in inquiry not as a checklist of skills, but as a dynamic process of sense-making. Such a shift is essential to fostering the competencies required for STEAM education, where students must find optimal solutions to complex, real-world problems.

Invited Speech

Building a Sustainable STEAM Education Ecosystem in Elementary Schools of Rural Southern Taiwan: The "Three Teachers + C" Co-Learning Model

Sheau-Wen Lin

College of Science
Department of Science Communication
National Pingtung University

Sheau-Wen Lin is a Professor at National Pingtung University, where she has dedicated her career to advancing science and STEM education, especially in teacher professional development. As the lead of the Project Suzaku Pioneer, a flagship University Social Responsibility (USR) initiative, she works to address educational challenges in rural southern Taiwan by connecting university resources with in-service and pre-service teachers. Her work focuses on building sustainable, technology-enhanced learning ecosystems and narrowing the gap between academic research and classroom reality. Through strategic collaborations with corporate ESG initiatives and non-profit organizations, she fosters a culture of co-creation that supports teacher growth and provides practical, impactful insights for the ongoing transformation of educational practice.

Abstract

Time 10:00-11:00 30 May, 2026
Location [D1-LP-07]

This presentation explores the innovative "Project Suzaku Pioneer" (朱雀先驅計畫), a University Social Responsibility (USR) initiative dedicated to advancing STEAM education specifically within the elementary school context of rural Southern Taiwan. Through the "Three Teachers + C" (University Faculty, Elementary School Teachers, and Pre-service Teachers + Community/Co-learning) framework, this model moves beyond traditional educational support by establishing a synergistic co-learning ecosystem. The project focuses on the unique developmental needs of primary school students, integrating academic expertise, the frontline pedagogical experience of local elementary educators, and the innovative co-creation of pre-service teachers to design context-based STEAM curricula. By employing a hybrid "summer intensive plus year-round online interaction" approach, the project overcomes the geographical barriers of remote regions. The presentation details how this collaborative strategy not only improves elementary students' STEAM literacy and language development but also institutionalizes governance and stable field accompaniment. Furthermore, by integrating USR with potential corporate ESG initiatives and NPO support systems, the project proposes a scalable blueprint for rural STEAM advancement and professional growth metrics, offering a sustainable model for educational equity in the East-Asian context.

Invited Speech

Improving Science Literacy through Local Wisdom-Based Citizen Science in Indonesia

Hadi Suwono

Faculty of Mathematics and Natural Sciences
Universitas Negeri Malang

Prof. Dr. Hadi Suwono, M.Si., is a Professor of Biology Education at the Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang. He is a distinguished Indonesian academic, researcher, and educator with extensive experience in secondary and higher education, scientific research, and community engagement. Throughout his career, he has actively contributed to the advancement of biology and science education through scholarly publications, collaborative research projects, academic conferences, and professional development programs. His research interests include biology education, innovative learning strategies, scientific literacy, and educational development. In addition to teaching and mentoring undergraduate and postgraduate students, Prof. Hadi has been involved in academic leadership and interdisciplinary collaboration to strengthen educational quality and promote sustainable knowledge dissemination. His dedication, professionalism, and commitment to academic excellence continue to inspire students, colleagues, and educational communities at both national and international levels through impactful academic and professional contributions.

Abstract

Time 11:30-12:15 30 May, 2026
Location [D2-LP-12]

The transformation of scientific literacy in Indonesia’ s remote, outermost, and least developed (3T) regions has found new momentum through the integration of local wisdom into citizen science models. This study explores how combining traditional values with public participation not only enhances students' scientific understanding but also fortifies the professional identity of frontline educators. Amidst a conceptual gap connecting ethnoscience with citizen science frameworks and teacher identity theories, this research steps in to provide critical answers. By adopting the PRISMA protocol, selected literature published between 2018 and 2025 was thoroughly analyzed using thematic approaches, bibliometric mapping, and meta-analytic synthesis. The data reveals that infusing local knowledge into the curriculum drastically increases learning relevance and creates a harmonious cultural synergy between schools and their communities. Quantitatively, a meta-analysis of 28 studies yielded a large effect size, proving a significant leap in scientific literacy when local wisdom is synergized with citizen science strategies. Impressively, 72% of the research noted tangible improvements in learning outcomes, while 64% reported strengthened motivation, self-efficacy, and cultural pedagogical competence among teachers. These findings provide a solid empirical foundation showing that culturally rooted science education in 3T regions is not merely a complementary element—it is a crucial necessity for achieving relevant and equitable education. A chronological analysis also highlights a progressive shift: from basic ethnoscience towards community-based educational models oriented around sustainability. As a transformative pedagogical asset, local wisdom has proven capable of strengthening contextual learning while simultaneously tightening social engagement. Therefore, sustained institutional commitment is essential to scale up this culture-based education. Moving forward, research priorities must focus on longitudinal designs and the standardization of models that successfully marry local values with STEM innovation and the global Sustainable Development Goals (SDGs).

Invited Speech

The Effect of Teachers' Use of Artificial Intelligence for Designing Science Learning on Students' Scientific Literacy

Chanyah Dahsah

Faculty of Science
Srinakharinwirot University

Dr Chanyah Dahsah is an assistant professor of science education. She received a Ph.D. in Science Education from Kasetsart University Thailand, in collaboration with the University of Waikato New Zealand, in 2007. Her teaching meets the criteria of the UK Professional Standards Framework (UKPSF) and is awarded as a senior fellowship by Advance HE. For her research experiences, she worked as a researcher for the CREATE for STEM Institute at Michigan State University in the US for the NGSS Collaborative Assessment Project and Interaction Project (2013-2015). Her current research studies are promoting ESD-STEM in early childhood education, developing school learning innovation using professional learning communities, and AI-integrated learning to enhance students' literacy.

Abstract

Time 14:30-15:30 30 May, 2026

Location [D2-LP-12]

Artificial Intelligence (AI) has been increasingly employed as an important tool to support learning in the 21st century and recognized as a key approach for promoting scientific literacy. This research explored how teachers use AI in designing learning and how its effect on students' scientific literacy. The research employed a mixed-methods intervention design with pre–post data collection. The participants were 86 teachers who participated in four two-day workshops from November 2025 to January 2026 about the use of AI for creating lesson plans, activities, assessments, and learning materials. The data about how teachers use of AI in designing learning was collected from reflection sessions about two weeks after each workshop, and one reflection section at the end of semester, March 2026. The data about the effect of teachers' use AI was collected from 3,392 students who were taught by participanting teachers using the scientific literacy test. The test was collected in November 2025 as a pretest, and in March 2026 as a posttest. The findings indicated that teachers not only used AI in designing learning that aligns with content standards, but also used it to encourage students' engagement and interest. In addition, students' scientific literacy showed significant improvement after learning with participating teachers. These findings provide important implications for the use of AI in designing science learning, and professional development programs, particularly regarding teachers' practices.

Details of Parallel Session 1

29 May 2026 | 11:30-12:15

1.1 Generative AI as Teaching & Assessment Tool [B4-LP-08]
When AI-TPACK Self-Reports Fail to Predict Design Quality: Evidence from a GenAI-Supported Multimodal Science Task **Ye Cao, Yuqi Liao and Quanling Li** (paper ID: 26)
Bridging Pedagogical Needs and Generative AI Capabilities: Design and Validation of the Human-Agent Co-Teaching (HACT) Framework in K-12 Science PBL Classrooms **Qing Guo** (paper ID: 41)
Constructing a GenAI-Mediated Framework for Bio-STEAM Virtual Inquiry-Based Experiments **Guohao Huang, Qiufen Li and Chunyan Feng** (paper ID: 49)
2.1 Scientific Literacy & 5G/STEAM Curriculum [D2-LP-07]
5G-Designed Lesson Exemplars to Promote Scientific Literacy among Grade 11 Learners **Heidi Abelita, Paul Jowen Blancaver and Mark Anthony Rupa** (paper ID: 4)
STE2AM Approaches to Education for Sustainable Development **Gillian Roehrig, Shuvra Rahman and Heba Eldeghaidy** (paper ID: 34)
Developing Digital Interactive Learning Module to Improve Students' STEM Literacy and Critical Thinking **Irma Rahma Suwarma, Riandi Riandi, Anna Permanasari and Beta Kurnia Ilahi** (paper ID: 90)
3.1 Integrating Traditional Culture & Local Knowledge [D2-LP-13]
Research on the Implementation Path of Traditional Chinese Herbal Medicine Culture in Primary School Science Education **Baoling Sun, Dongmei Fan, Ruwei Jin and Zhuangli Zhu** (paper ID: 5)
Science Curriculum Development Grounded in Industrial Culture: Theoretical Implications and Practical Pathways **Wang Qi** (paper ID: 6)
Nomadic Pastoralism as a Lens for Place-Responsive Science Education: Insights from Mongolia **Shinetsetseg Gerelkhuu, Hiroki Fujii, Batchuluun Yembuu, Uranchimeg Getsel, Uuriintuya Dembereldorj and Khalifatulloh Field'Ardh** (paper ID: 66)
4.1 Student Cognitive Processes & Personal Characteristics [D2-LP-14]
The Relationship between High School Students' Cognitive Processes during Science Problem-Solving Tasks and Their Personal Characteristics **Manami Sano, Mikiharu Ishitobi and Takuya Matsuura** (paper ID: 33)
Do Instructional Strategies at the Beginning of a Unit Arouse Students' Interest in Science Lessons? **Kota Hashimoto, Takuya Matsuura and Mikiharu Ishitobi** (paper ID: 39)
A Survey of High School Students' Perceptions of Physics and Sustainability **Keiya Muramatsu and Koto Yamamoto** (paper ID: 52)
5.1 Higher-Order & Systems Thinking [D2-LP-10]
From Error to Uncertainty: Shifting to a Probabilistic Framework in Experimental Instruction for the Korea Junior Science Olympiad **Youngseok Jhun and Hyoung Yong Park** (paper ID: 35)
Cultivation of Senior High School Students' Systems Thinking about Chemistry-related Socio-scientific Issues **Yan Wu and Anthony Cheng** (paper ID: 50)
Climate Change Education in Continuing Professional Development: Evidences from Teacher Workshops in Four Asian Cities **Khalifatulloh Fiel'Ardh, Hiroki Fujii, Ari Widodo, Munirah Ghazali, Jestoni Babia and Sweta Purohit** (paper ID: 57)

Details of Parallel Session 2

29 May 2026 | 16:00-16:45

1.2 AI-assisted Text Analysis & Argumentation Assessment [B4-LP-08]
Towards an Interpretive Framework for Comparing the Affordance of AI-Generated Science Texts **Ka Lok Cheng** (paper ID: 25)
An Analysis of Integration: Does That A.I. Detectable? Looking at Some Implementations Through the Lens of Integration Theory **Tomoki Saito** (paper ID: 81)
A Study on the Impact of Multi-agent System-Based Scientific Argumentation Environment on Pre-service Teachers' Argumentation Abilities **Tingting Li, Huijun Wang, Shuhui Zhu and Zhaojie Hao** (paper ID: 80)
2.2 Science/STEM Identity [D2-LP-07]
Identity of Expert Science Teachers: A Phenomenographic Study in the Chinese Context **Chengshu Luo, Binbin Cai and Xiufeng Liu** (paper ID: 15)
What is STEM Identity? A Phenomenographic Study of Chinese Students in Grades 4-12 **Binbin Cai, Chengshu Luo and Xiufeng Liu** (paper ID: 16)
Relationships among Components of Students' Science Identity: A Structural Equation Modeling Study **Chen Zhen, Xiufeng Liu and Mi Shuaishuai** (paper ID: 54)
3.2 Education for Sustainable Development & SSI [D2-LP-13]
Sustainability as a Context for Inquiry-Based Science Education: Design and Outcomes of an ASEAN+3 Student Camp for the Gifted in Science Program **Soo-Young Lee** (paper ID: 44)
Towards a more informed decision-making on socio-scientific issues: A modelling-based pedagogical framework **Zeyu Han and Chen Chen**(paper ID: 83)
Beyond Universal Principles: Proposing the Science-Validated Ocean Systems Scheme (SV-OSS) to Diagnose Divergent Textbook Enactments of Ocean–Atmosphere Literacy in China's Unified Curriculum **Yupeng Wang, Yujing Guo and Xin Bai** (paper ID: 45)
4.2 Science Conceptual Understanding & Misconceptions [D2-LP-14]
Metacognitive Regulation of Teleological and Lamarckian Misconception in Student Explanations of Phenotypic Change **Yaeko Otaka and Khalifatulloh Fiel'Ardh** (paper ID: 51)
The Significance of Direct Experience with Nature: A Historical Perspective on Approaches in Intuitive Teaching in Japan **Yuya Nakanishi** (paper ID: 55)
Animal Care in Living Environment Studies: Research Trends on Coexistence between Animals and Humans in Japan **Karen Onodera** (paper ID: 65)

Details of Parallel Session 3

30 May 2026 | 10:00-11:00

1.3 AI Educational Platforms & Self-Directed Learning [D2-LP-08]
Development of an AI-powered EdTech Platform and Teacher Professional Development Package to Promote Primary Students' Self-Directed Learning **Wing Man Poon and Ka Lok Cheng** (paper ID: 24)
Development and Implementation of an EdTech-Based Ecology Education Program to Enhance Ecological Sensitivity and Digital Literacy **Sumi Jo, Young Joon Shin and Hyoung Yong Park** (paper ID: 62)
AI-empowered Project-Based Teaching of "Exploring the Value of Highland Barley, a Characteristic Cereal in Tibetan Regions": Sugar **Min Luo** (paper ID: 113)
2.3 Creative Thinking & Problem Solving [D2-LP-10]
Pathways to Scientific Creativity: A Meta-Analytic Structural Equation Modelling of Relationships among Scientific Knowledge, Divergent Thinking, Convergent Thinking, Critical Thinking and Scientific Creativity **Shuaishuai Mi and Xiufeng Liu** (paper ID: 30)
Enhancing Fifth Grade Students' Creative Thinking in University Demonstration School Through Sky and Constellations STEAM Learning Activities **Supaluk Srikachin and Tepkanya Promkatkeaw** (paper ID: 61)
An Analysis of the Internal Structure of Creative Self-Concept among Secondary School Students: A Physics-Based Survey **Xinxin Dong (Online)** (paper ID: 18)
3.3 STEAM Curriculum Design & Implementation [D2-LP-13]
The Role of Teachers in STEAM Education: A Case Study of Shokuiku (Food and Nutrition Education) in Japan **Tetsuo Isozaki, Hirohito Higuchi, Takuya Ochi, Takako Isozaki and Mahiro Nakayama** (paper ID: 42)
Model Construction and Implementation Path of Cultural Inheritance Comprehensive Practical Activity Curriculum from the Perspective of STEAM Education **Guanyou Shang, Xinyue Shen, Yunzhu Wang, Wenhui Zhao and Chunyan Feng**(paper ID: 58)
Present Human Ecosystem Development for the STEAM Education Movement and What Needed in terms of International Partnership **Yoshisuke Kumano, Naoshi Watanabe and Shuji Kurebayashi** (paper ID: 92)
4.3 Attitude towards Science [D2-LP-14]
Development of High School Physics Lessons to Enhance Students' Learning Attitudes —Through Unit-Wide Lesson Design Using a Context-Based Approach— **Koto Yamamoto** (paper ID: 53)
Extracurricular Experiences as a Driver for Agency in Pre-Service Science Teacher Education: An Autoethnographic Study **Sena Tanaka and Khalifatulloh Fiel'Ardh** (paper ID: 64)
"Learning while feeling": An exploratory analysis of students' emotional flow in life-value-oriented SSI learning **Zuotian Qu (Online) , Yuanhe Zheng and Tian Luo** (paper ID: 21)

Details of Parallel Session 4

30 May 2026 | 11:30-12:15

1.4 AI & AR Scaffolding for STEM Design [D2-LP-08]
The Impact of an AI-Enhanced Invention Education Program on Elementary Students' Problem Recognition Ability **Hyeonjin Kim and Hyoung Yong Park** (paper ID: 63)
Harnessing Augmented Reality for Scaffolding Students' STEM Design Practices **Jina Chang** (paper ID: 103)
Designing an AIGC-Empowered STEAM Curriculum for Local Culture: A Case Study of "Chaoshan Dancong Tea" **Yuxing Li and Chunyan Feng** (paper ID: 46)
2.4 Problem solving & Design in STEM education [D2-LP-10]
From Following Instructions to Leading Innovation: A Qualitative Study of Student Agency in STEM Maker Education **Zhihong Wan and Zhaoxi Liu** (paper ID: 122)
Understanding the Dynamics of Creative Interdisciplinary Problem-Solving in STEM Learning: A Cultural-Historical Activity Theory Study **Yue Chen and Xiufeng Liu** (paper ID: 36)
The Transition of Problem-solving Learning Design in Japanese Elementary School Science Education **Toshihide Hirano (Online)** (paper ID: 71)
3.4 Inquiry-Based & Project-Based Learning [D2-LP-13]
Research on the Curriculum Design Path and Implementation Framework of Comprehensive Practical Activities Incorporating Vocational Experiences **Jiaxuan Hu, Yiying Huang and Chunyan Feng** (paper ID: 48)
Understanding Primary Science Teachers' Intentions to Implement Project-Based Learning: Evidence from the Knowledge–Attitude–Behaviour Model **Shuhan Yuan,Yan Dong and Siqi Li** (paper ID: 82)
Beyond Linear Processes: A Spiral Model for Interdisciplinary Project-Based Learning from a Curriculum Enactment Orientation **Xiang Li, Qiufen Li and Chunyan Feng** (paper ID: 84)
4.4 Science Process Skills & Communication [D2-LP-14]
Science Show as a Learning Platform for Developing Science Process Skills in Upper Secondary Schools **O-Phart Phrathep** (paper ID: 74)
Assessment System for Science Learning Based on Situational Inquiry **Yangmei Zhong** (paper ID: 88)
Analysis of Students' Communication Skills in Science Learning Based on Engineering Design Process Stages in Small Group Discussion **Pramudya Dwi Aristya Putra (online), Albertus Djoko Lesmono and Devi Yustika** (paper ID: 47)

Details of Parallel Session 5

30 May 2026 | 14:30-15:30

1.5 Student Epistemic Interaction with AI [D2-LP-08]
GenAI-Driven Instructional Paths for A-STEM in Secondary School Biology **Wang Yunzhu, Shang Guanyou, Shen Xinyue, Zhao Wenhui, and Feng Chunyan** (paper ID: 59)
From Tool to Peer: Cognitive Risks and Tiered Collaboration in AI-Enabled Primary Science Classrooms **Dongping Fan and Lili Li** (paper ID: 89)
Middle School Students' Epistemic Vigilance in Co-Constructing Scientific Explanations with Generative AI **Sally Gutierez (Online)** (paper ID: 105)
2.5 Interdisciplinary Competence & STEM Literacy [D2-LP-10]
Review of Interdisciplinary Competence **Yiying Huang, Jiaxuan Hu, Xiang Li, Zhe Zhou and Chunyan Feng** (paper ID: 43)
Breaking the Dilemma and Reconstructing the Curriculum: An Experimental Study on the Reform of Psychology Research Methods Course Empowered by the STEAM Concept **Xiaoli Zhang** (paper ID: 97)
Study on the Recognition of Competency Models of the STEM Human Resources Community Influences on Majors : Focus on Higher Education Students in Japan and Thailand **Tomotaka Kuroda** (paper ID: 87)
3.5 Textbook & Material Content Analysis [D2-LP-13]
Treatment of Climate Change Content in Science Education in Indian Compulsory Education: An Analysis of NCERT Textbooks **Ken Kawai and Hiroki Fujii** (paper ID: 31)
Rika (science education) Competencies in the Japan's Course of Study : Analyzing the Discussions in the Rika Working Group in the 2017 Revision **Hiroaki Okada, Junye Gao and Tetsuo Isozaki** (paper ID: 69)
Research Landscape of Scientists' Engagement in K-12 Science Education: A Bibliometric and Content Analysis **Minyi Liu, Jin Shen and Rui Wei** (paper ID: 67)
4.5 Teacher Design Capacity & Planning Tools [D2-LP-14]
Enhancing Biology Teachers' Pedagogical Design Capacity Through an Inquiry-Focused Planning Tool **Nga Yung Yiu** (paper ID: 8)
Enhancing Teachers' Scientific Inquiry Pedagogy and Global Perspectives through a Cross-National Teacher Workshop: Evidence from ASEAN+3 Gifted Science Teachers **Sung Hee Lee and Soo-Young Lee** (paper ID: 70)
Latent Growth of Elementary Science Teachers' Epistemic Orientation with the Curve-of-factors Model **Chenchen Ding, Gavin Fulmer, Lesa Hoffman, Brian Hand and Jee Suh** (paper ID: 23)

Details of Parallel Session 6

30 May 2026 | 16:00-17:00

1.6 Technology Integration in Teacher Education [D2-LP-08]
Generative AI–Supported Multimodal Composing in a Teaching Methods Course: Insights from Preservice Science Teachers **Song Xue** (paper ID: 12)
Technology Empowerment in Teacher Education: Model Construction and Practical Strategies for Developing Teachers' AI Literacy **Qiufen Li, Guohao Huang, Xiang Li and Chunyan Feng** (paper ID: 56)
From Novice to Competent: A Grounded Theory Analysis of Difficulties and Strategies in In-service Kindergarten Teachers' STEAM Professional Development **Wenchao Zhang, Yuanyuan Gu and Chang Liu** (paper ID: 106)
2.6 Career Expectation & After-school STEM Activities [D2-LP-10]
The Impact of After-School STEM Activities on Primary School Students' STEM Career Intentions **Jiaru Lv, Yajing Gu, Qi Zhang and Siqi Li** (paper ID: 100)
An overview of applications and trends of science inquiry for learning effectiveness: an umbrella review **Shuo Shan and Yang Yang** (paper ID: 123)
Assessing biology career-related outcome expectations and exploring their predicting effect on students' career-related choices **Yueling Sun, Hanyu Wu (Online) and Tian Luo** (paper ID: 37)
3.6 Preservice Teacher Cognition & Professional Identity [D2-LP-13]
Right, Wrong… or Something More? Examining Thai Preservice Science Teachers' Perceptions of Noticing Students' Responses **Witchayada Nawanidbumrung** (paper ID: 20)
An Exploratory Study on Preservice Chemistry Teachers' Designing ESD-STEM Lesson Plans connecting Confucianism **Baoyu Li, Kexin Wu and Boya Wang** (paper ID: 85)
Exploring the Development of Pre-service Science Teachers' Professional Identity in Science Museums: A Case Study **Yajing Gu, Qi Zhang, Ruiqi Yu and Yang Yang** (paper ID: 99)
4.6 Assessment Methods & Tool Development [D2-LP-14]
Construction of the Assessment Framework for the View of Life Information in High School Biology **Zhe Zhou, Yiying Huang, Xinyue Shen, Xiang Li and Chunyan Feng** (paper ID: 60)
Comparing Paper-and-Pencil and Computer-Based Assessments in Science: Evidence from Grades 5–8 **Ruiqi Yu, Jiaru Lv, Yang Yang and Yafeng Zheng** (paper ID: 101)
Developing Teaching Competence Indicators for Clinical Psychologists under CBME: A Delphi-Based Research in Progress **Zhi-Yue Gao (online)** (paper ID: 38)

Details of Parallel Session 7

30 May 2026 | 17:00-17:30

1.7 Generative AI-Assisted Assessment of Scientific Literacy [D2-LP-08]
Generative AI for Assessing and Facilitating Elementary Students' Epistemic Understanding of Scientific Inquiry **Jina Chang, Jisun Park and Ju Yeon Sim** (paper ID: 104)
Feasibility of Automatically Assessing Junior High School Students' Chemistry Argumentation Level Using Large Language Models ——A Comparison Based on GPT-4.5 and DeepSeek-R1 **Lan Haihang** (paper ID: 108)
2.7 Review of Emerging Issues in Science Education [D2-LP-10]
Translating Frontier "AI-Chemist" Achievements into Science Curricula: Bridging Classical and Contemporary Scientific Practices **Chenglin Miao, Jin Shen and Rui Wei** (paper ID: 40)
Fuel Chemistry and Sustainability in the Context of Brunei Darussalam: A Teacher's Autoethnography **Siti Jurainah Junaidi and Khalifatulloh Fiel'Ardh** (paper ID: 86)
3.7 Teacher Beliefs, Orientation & Reflection [D2-LP-13]
Multifaceted Influences of Instructional Practices on Intentions to Foster Higher-order Thinking Skills: A Comparison of Japanese and Filipino Junior High School Science Teachers **Mikiharu Ishitobi and Takuya Matsuura** (paper ID: 78)
Instructional Approaches to Foster Higher-Order Thinking in Lower Secondary Science Classrooms: A Qualitative Analysis of Teachers' Practices **Takuya Matsuura** (paper ID: 114)
4.7 Teacher Professional Development Models & Pathways [D2-LP-14]
Exploring the Journey of Science Teachers' Adaptive Expertise Development in Educational Technology Integration: Focusing on Threshold Practices **Heesoo Ha, Seungho Maeng, Phil Seok Oh and Jin-Ju Pyo** (paper ID: 27)
Bridging Policy and the Science Classroom: A Pilot Study of a Teachers' Professional Development Program on Generative AI Adoption in the Philippines **Lowell Gabunilas and Rolando Obiedo** (paper ID: 29)

Details of Greater Bay Area Forum
粤港澳大湾区科学教育论坛

1. 大湾区科学教育论坛 1 [B4-LP-08] *29 May 2026 | 11:30-12:15*

国防科技后备人才培养模式的困境与突破——基于人的全面发展理论的路径探索
王映 (paper ID: 216)

STEM理念下的初中"生物+"跨学科教学实践——以"校园生态地图"为例
张琴, 王华征 (paper ID: 214)

STEAM教育中工程思维的培养路径探索与实践——以『电磁弹射器』项目
姜传星, 姚海霞, 展兴海, 段杉杉 (paper ID: 222)

指向高阶思维发展的科学教育分层进阶模式构建
黄炳超, 董一名, 沈姝含 (paper ID: 223) (Online)

2. 大湾区科学教育论坛 2 [D1-LP-08] *29 May 2026 | 16:00-16:45*

生成式人工智能背景下职前幼儿教师STEAM素养的培养路径与机制研究
任丽婵 (paper ID: 226)

职前科学教师对探究式教学"失控"的恐惧 ——基于比斯塔"教育之弱"的多案例研究
赵文清 (paper ID: 115)

国家意志与公民教育：美国科学素养制度化的历史逻辑（1945-1995）
付庭松 (paper ID: 112)

链接·赋能·生成：AI驱动的馆校协同STEM探究课程开发与素养培育
吴跃辉 (paper ID: 219) (Online)

3. 大湾区科学教育论坛 3 [D2-LP-10] *29 May 2026 | 16:00-16:45*

基于STEAM教育理念的小学科技模型课程开发与应用研究
陈立志 (paper ID: 98)

STEAM课堂话语如何驱动高阶思维发展？——基于滞后序列分析的实证研究
袁磊, 龙露露, 李丽均, 周乐莹 (paper ID: 107)

从流程导向到能力发展：基于中国课标与加拿大安大略省课标中科学探究框架的比较
邱惠芬, 万志宏, 蓝海航 (paper ID: 109)

面向拔尖创新人才早期培养的STEM课程研究——基于泰勒原理的视角
马乃珍 (paper ID: 215) (Online)

4. 大湾区科学教育论坛 4 暨科学素养提升联盟会议 [D2-LP-03] *30 May 2026 | 10:00-11:00*

以社会性科学议题学习驱动区域科技教育的"环翠方案"
王静 (paper ID: 120) (Online)

基于社会性科学议题的跨学科实践活动设计——以"'七日减肥食谱'真的健康吗？"为例
龚颖, 曹颖, 张崇华, 丁满花 (paper ID: 202) (Online)

在海洋教育中的实践探索与启示——以威海"海滨城市海洋牧场推广"项目为例
崔文浩 (paper ID: 206) (Online)

Details of Greater Bay Area Forum
粤港澳大湾区科学教育论坛

5. 大湾区科学教育论坛 5 [D1-LP-08]	*30 May 2026 | 11:30-12:15*
多智能体赋能小学STEM教育研究：协同机制、关键模式及实施保障 **卢怀裕, 张誉月, 吴强** (paper ID: 217)	
十万个为什么：基于红树林保护区的校外科学探究实践课程开发与实施 **吴黛** (paper ID: 213)	
资源配置视角下粤港澳湾区小学科学教育的公平与包容路径 **张杰志** (paper ID: 220)	
智能时代基于深度学习的单元教学设计与实践 **吕小珍, 汤祖军** (paper ID: 218)	
6. 大湾区科学教育论坛 6 暨科学素养提升联盟会议 [D2-LP-03]	*30 May 2026 | 11:30-12:15*
市井烟火中的SSI校本课程探索与实践 **李蕾, 刘才胜** (paper ID: 207) (Online)	
基于现实议题的跨学科教学设计与实践——以“鱼菜共生”为例 **王子洁, 吴彦军, 张黛静** (paper ID: 208) (Online)	
社会性科学议题视域下中学“低碳校园”跨学科课程的设计与实施 **王成, 罗铣吉, 孙翊斐, 李梦豪** (paper ID: 210) (Online)	
数智时代科学家精神的具身化传承：三元对话机制在化学科普实践中的社会教育功能研究 **李佳** (paper ID: 212) (Online)	
7. 大湾区科学教育论坛 7-11 [D1-LP-08]	*30 May 2026 | 13:30-17:30*
指向探究实践核心素养育人的科技教育课程建设思考与行动 **罗星凯**	
从《光的直线传播》实验，解析数字化实验对学生科学模型构造能力的提升 **李鼎**	
构建链式育人体系，打造科技教育新样式——广州大学附属中学的实践探索 **姚海霞**	
敏捷治理视域下 UGS 科学教育模式探索——以“海岛项目”科学探究课程为个案 **叶碧欣、曾飞鹏**	
科技赋能非遗传承：初中英歌舞校本课程数字化资源库的构建与教学实践研究 **潘颖懿**	
深圳中学数理高中课例分享 **冯丹**	
华南师范大学附属荔湾小学课例分享 **何向梅**	
佛山市禅城区澜石小学课例分享 **钟丽婷**	
香港九龙妇女福利会李炳纪念学校课例分享 **彭英麟**	
香港佛教志莲小学课例分享 **谈嘉豪**	
澳门培正中学课例分享 **林达鑫**	
研讨交流,会议总结 **董艳**	

会议场地地图 Venue Map

The Education University of Hong Kong
Tai Po Campus
香港教育大學大埔校園

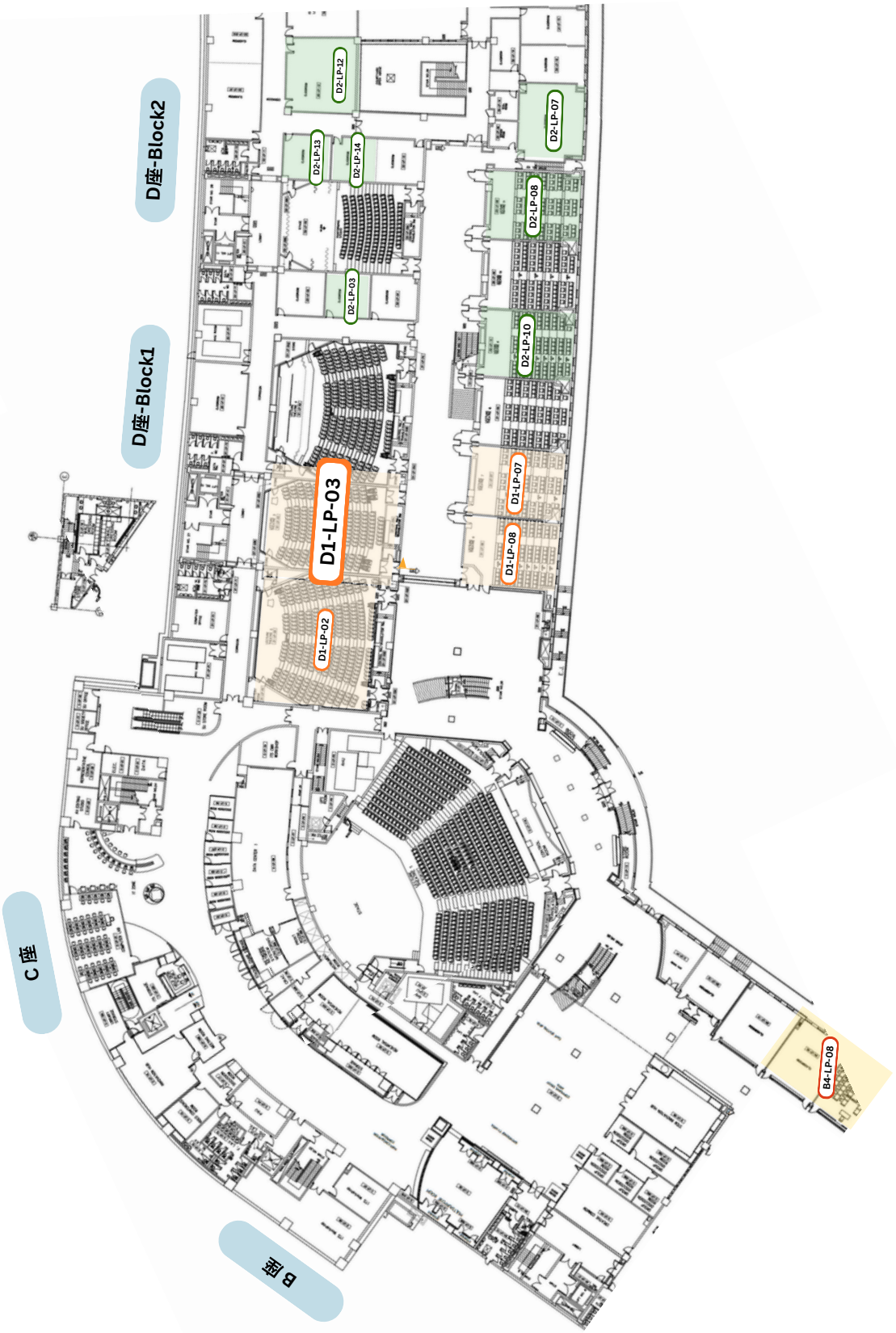
NOTE: 会议场地主要分布在BLOCK E 和BLOCK D。 Conference venues are mainly located in BLOCK E and BLOCK D.

1. Taxi/Bus 的士站/巴士站
2. Pedestrian Entrance 行人入口
3. New Academic Building 新教學大樓
4. D-Academic Building North Wing D座-教學大樓北翼
5. C-Central Facilities Building And Mong Man Wai Library C座-中央大樓及蒙民偉圖書館

新教學大樓

3 New Academic Building
新教學大樓

会议场地地图 Conference Venue Map



D-Academic Building North Wing
D座-教學大樓北翼

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地址：
香港新界大埔露屏路十号

Address:
10 Lo Ping Road, Tai Po, New Territories, Hong Kong

公共交通：

- 九巴74K巴士来往港铁大埔墟站及三门仔途经教大（中午12时前，从大埔墟站先到香港教育大学；中午12时后， 先往三门仔再到香港教育大学）
- 公共专线小巴26号来往大埔校园及马鞍山海柏花园
- 公共专线小巴26A号辅助线，往来大埔校园至大埔元洲仔（循环线），服务时间週一至五每日上午7:30至9:30以及下午5:30至8:30

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- KMB No. 74K from Tai Po Market MTR Station to Sam Mun Tsai via Tai Po Campus (before 12:00 n.n. the bus will call at Tai Po Campus and after 12:00 n.n. will go to Sam Mun Tsai first before calling at Tai Po Campus)
- Green Minibus No. 26 from Tai Po Campus to Bayshore Towers, Ma On Shan and vice versa
- Green Minibus No. 26A from Tai Po Campus to Yuen Chau Tsai, Tai Po circular service (7:30 am to 9:30 am & 5:30 pm to 8:30 pm, Monday through Friday)

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- 会议穿梭巴士来往大埔校园及港铁大学站

Shuttle Bus Services🌟:

- Shuttle Bus from Tai Po Campus to University MTR Station and vice versa

	29 May 2026 (Friday)	30 May 2026 (Saturday)
Time	University MTR Station --> EdUHK Tai Po Campus - Departure Time: 8:00am, 8:10am, 8:20am & 8:30am EdUHK Tai Po Campus --> University MTR Station - Departure Time: 5:50pm, 6:00pm, 6:10pm & 6:20pm	University MTR Station --> EdUHK Tai Po Campus - Departure Time: 8:00am, 8:10am, 8:20am & 8:30am EdUHK Tai Po Campus --> University MTR Station - Departure Time: 5:50pm, 6:05pm EdUHK Tai Po Campus --> Parc88 (10 Science Park West Avenue, Phase 2, Hong Kong Science Park) - Departure Time: 5:50pm, 6:00pm Parc88 (Science Park) --> University MTR Station - Departure Time: 9:30pm, 9:35pm

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29 May 2026 | 11:30-12:15

Abstracts of Parallel Session 1

1.1 Generative AI as Teaching & Assessment Tool [B4-LP-08]

When AI-TPACK Self-Reports Fail to Predict Design Quality: Evidence from a GenAI-Supported Multimodal Science Task (paper ID: 26)

Ye Cao (Hainan Normal University); Yuqi Liao (Hainan Normal University); Quanling Li (Hainan Normal University)

Keywords: Teacher Education, Mixed-method Research, Empirical Study, AI-TPACK
Abstract: Self-report AI-TPACK scales are increasingly used to gauge teachers'readiness for an AI-rich future, yet their validity is uncertain when the target construct is enacted design competence. This study tests the alignment between pre-service science teachers' AI-TPACK self-reports and performance in a generative-AI-supported multimodal design task. Participants were 116 pre-service primary science teachers in a compulsory methods course at a normal university in China. All completed a validated seven-dimension AI-TPACK questionnaire and produced an assessed artefact: an HTML-based animation/interactive explanation of Earth's seasons, created with GenAI support. Coursework were scored with a 21-item TPACK-aligned rubric using two trained raters and calibration rounds. In a convergent mixed-methods design, quantitative analyses (e.g., CFA, regressions) were integrated with six focus groups (n = 24) that probed item interpretation and task experience. Results show a systematic misalignment. The questionnaire exhibited an acceptable seven-factor structure, yet self-report scores were largely unrelated to rubric-based performance across domains (with only a small cross-domain association between reported PK and task-based TK). Categorical profiling further indicated consistent overestimation in self-ratings relative to performance, and background variables explained little variance. Focus-group data suggest three mechanisms: participants anchored responses in familiar, non-design teaching scenarios; they perceived AI tools as unreliable for debugging and complex production; and they used AI primarily to compensate for content gaps, yielding a "content-support" orientation that did not translate into technical implementation. The findings caution against stand-alone self-report use and support combining questionnaires with performance evidence for defensible AI-TPACK interpretations.

Bridging Pedagogical Needs and Generative AI Capabilities: Design and Validation of the Human-Agent Co-Teaching (HACT) Framework in K-12 Science PBL Classrooms (paper ID: 41)

Qing Guo (Central China Normal University)

Keywords: Primary education, Mixed methods research, Multi-agent systems, Science project-based learning
Abstract: In K-12 science project-based learning (PBL), educators frequently encounter difficulties in delivering timely, individualized instruction and process-oriented feedback. The emergence of generative artificial intelligence, particularly large language model (LLM)-powered agent techniques, offers promising solutions to address intelligent shortcomings in specialized domains, thereby presenting novel opportunities to overcome PBL classroom challenges. Nevertheless, relative research in science education remains nascent, predominantly focus on theoretical viability, technical outputs, or human perceptions, failing to establish concrete design principles for personalized environments characterized by triadic "Teacher-Student-Agent" interactions. Grounded in distributed cognition theory, this study introduces the Human-Agent Co-Teaching (HACT) framework. HACT incorporates two pivotal mechanisms: (1) a multi-agent system architecture informed by self-regulated learning principles, featuring specialized agents for distinct PBL phases to facilitate personalized inquiry; and (2) interaction protocols derived from classroom orchestration theory that optimize agents' deployment timing, scaffolding techniques, and educator mediation strategies. Through a design-based research approach centered on an elementary "Model Boat Construction" unit, we instantiated a five-agent system (comprising Foundation Tutor, Materials Coach, Design Adviser, Production Guide, and Evaluator), articulating its workflow logic and artifact-driven operational dynamics while providing exemplar orchestration scripts. Quasi-experimental results indicate that the HACT framework yields statistically significant improvements in students' LLM utilization competencies and science content mastery. Ultimately, this study bridges the gap between technical capability and pedagogical application, contributing actionable theoretical constructs, technological blueprints, and instructional strategies for meaningful AI integration in K-12 science education.

Constructing a GenAI-Mediated Framework for Bio-STEAM Virtual Inquiry-Based Experiments (paper ID: 49)

Guohao Huang (South China Normal University), Qiufen Li (South China Normal University), Chunyan Feng (South China Normal University)

Keywords: GenAI, Biological virtual experiment, 5E-STEAM framework, Interdisciplinary inquiry
Abstract: To address the challenges in biological virtual experiments—namely the invisibility of microscopic mechanisms, superficial interdisciplinary integration, and the disconnection between scientific theory and engineering practice—this study constructs a GenAI-mediated Bio-STEAM framework for virtual inquiry-based experimental teaching. By embedding the dynamic mediating capabilities of generative artificial intelligence into the inquiry cycle of Engagement, Exploration, Explanation, Elaboration, and Evaluation, the framework adopts the case design of "Cell Membrane Structure and Function" as its core logical thread. It reconstructs an inquiry process that intricately weaves scientific reasoning with artistic expression, enabling a transformative progression from scientific principles to engineering prototypes and generative art. Furthermore, through comprehensive tracking of behavioral trajectories and competence-based profiling throughout the process, the framework fosters students' development of evidence-based reasoning, engineering thinking, and generative creativity while addressing complex real-world problems.

29 May 2026 | 11:30-12:15

Abstracts of Parallel Session 1

2.1 Scientific Literacy & 5G/STEAM Curriculum [D2-LP-07]

5G-Designed Lesson Exemplars to Promote Scientific Literacy among Grade 11 Learners (paper ID: 4)

Heidi Abelita (San Pascual National High School), Paul Jowen Blancaver (Department of Education - Schools Division Office of Masbate), Mark Anthony Rupa (Department of Education - Schools Division Office of Masbate)

Keywords: Scientific literacy, 5G framework, Contextualized instruction, Inclusive pedagogy, Multilingual classrooms
Abstract: Scientific literacy is essential for developing critical thinking and problem-solving skills; however, persistent gaps in conceptual understanding are evident in both global assessments and local school contexts. At San Pascual National High School, only 19.85% of Key Stage 4 learners met the expected literacy level, and Grade 11 students showed weak performance in Earth and Life Science due to limited English proficiency and insufficiently contextualized instruction. This study examined the effectiveness of 5G-designed lesson exemplars in improving scientific literacy and understanding of genetic engineering among Grade 11 learners. A mixed-methods design was employed, utilizing a pretest–posttest approach and qualitative data collected through classroom observations and learner interviews. Lessons were guided by the 5G Framework of Filipino Teaching and Learning, an experiential and hybrid-flexible model comprising five interrelated elements: Ganda (beauty), activating prior knowledge and contextualizing content; Galing (skill), fostering mastery and collaboration; Gahum (power), leveraging technology and instructional media; Giliw (affection), cultivating empathy through authentic problem-solving; and Gugma (love), promoting sustained motivation and meaningful learning. Quantitative analysis showed significant improvement in learners' understanding, with posttest scores ($M = 7.38$, $SD = 2.46$) higher than pretest scores ($M = 5.14$, $SD = 2.85$), $t(27) = 3.74$, $p < 0.05$. Qualitative findings confirmed the framework's impact on comprehension, collaboration, engagement, empathy, and motivation. Despite time and technology constraints, 5G-designed lessons effectively enhance scientific literacy through inclusive, contextualized instruction in multilingual classrooms.

STE²AM Approaches to Education for Sustainable Development (paper ID: 34)

Gillian Roehrig (University of Minnesota), Shuvra Rahman (University of Minnesota), Heba Eldeghaidy (American University of Cairo)

Keywords: STEAM, Curriculum development, Education for sustainable development
Abstract: In the face of escalating global environmental crises, the need for sustainable development has become critical, demanding transformative educational approaches that empower individuals and communities to contribute meaningfully to a more sustainable future. One such approach to Education for Sustainable Development (ESD) is STE²AM (Science, Technology, Engineering, ESD, Arts, and Mathematics), a framework that intentionally weaves together diverse disciplines to foster 21st century skills. STE²AM provides a framework for addressing the interdisciplinary nature of ESD, encouraging learners to draw different disciplinary lenses to address real-world problems. This study explored how undergraduate students at a private university in Egypt applied the STE²AM framework to develop ESD curricular units. Working in small, four STE²AM curriculum units were developed. Findings showed that the STE²AM framework provides a strong foundation for ESD curriculum development. Units were focused on local issues, for example exploring waste management in Cairo where most of 15,000 tons of waste produced every day is dumped in streets and waterways. Activities addressed the environmental, social, and economic pillars of ESD connecting to ecological impacts on the Nile, impacts on health, and informal communities who make a living recycling waste. Each unit purposefully integrated art and art-based pedagogies. For example, the waste management project explored the creative use of waste materials to create new products. Activities also explicitly engaged students in developing solutions to their chosen issue, promoting problem solving, creativity, and communication. While this project was developed in Egypt, the STE²AM framework is applicable to other regions across the world.

Developing Digital Interactive Learning Module to Improve Students' STEM Literacy and Critical Thinking (paper ID: 90)

Irma Rahma Suwarma (Universitas Pendidikan Indonesia), Riandi Riandi (Universitas Pendidikan Indonesia), Anna Permanasari (Universitas Pendidikan Indonesia), Beta Kurnia Ilahi (Universitas Pendidikan Indonesia)

Keywords: Digital Interactive Learning Module, STEM Literacy, Critical Thinking Skills, Global Warming
Abstract: This study aims to develop a STEM-based Digital Interactive Learning Module (DILM) designed to enhance senior high school students' STEM literacy and critical thinking skills on the topic of global warming. The research employed a Research and Development (R&D) method using the 4D model (Define, Design, Develop, Disseminate). Participants consisted of 36 grade X students from a senior high school in Bandung, Indonesia. Instruments included STEM literacy tests for knowledge, questionnaires and observation sheets for attitudes and skills, critical thinking tests, and expert validation sheets to assess module feasibility. Validation results indicated that the module was feasible and categorized as very good in terms of content, design, and readability. The developed module integrates STEM aspects into contextual learning activities, incorporates critical thinking indicators, and utilizes interactive features such as Liveworksheet, Google Docs, PhET Simulation, and Quizizz. Research findings showed improvements in STEM literacy, with N-Gain scores of 0.62 in science literacy, 0.58 in technology–engineering literacy, and 0.56 in mathematics literacy, all in the moderate category. Attitudes and skills also demonstrated positive responses with active participation in project-based tasks. Critical thinking improved with an average N-Gain of 0.53 (medium), with the highest gain in focusing questions and the lowest in decision-making. Thus, the STEM-based DILM is effective in enhancing STEM literacy and critical thinking, offering a contextual and innovative approach relevant to 21st-century education.

29 May 2026 | 11:30-12:15

Abstracts of Parallel Session 1

3.1 Integrating Traditional Culture & Local Knowledge [D2-LP-13]

Research on the Implementation Path of Traditional Chinese Herbal Medicine Culture in Primary School Science Education (paper ID: 5)

Baoling Sun (Tianjin Normal University), Dongmei Fan (Tianjin Normal University), Ruwei Jin (Tianjin Normal University), Zhuangli Zhu (Tianjin Normal University)

Keywords: Implementation path, Traditional chinese herbal medicine culture, Primary school
Abstract: This thesis focuses on the innovative integration and implementation paths of traditional Chinese herbal medicine culture in primary school science education. As an important part of China's excellent traditional culture, traditional Chinese herbal medicine contains rich scientific education resources. Its integration with primary school science education is an important way to cultivate students' scientific literacy and cultural identity. Based on the C-STEAM theory, this paper systematically sorts out four main models: curriculum integration, practical activities, digital empowerment, and collaborative education. Through the analysis of typical cases, it explores the practical characteristics and effects of different paths. The research finds that the effective integration of traditional Chinese herbal medicine culture and science education can stimulate students' interest in exploration and enhance cultural confidence. However, it still faces challenges such as an incomplete curriculum system, weak teaching force, and the absence of an evaluation mechanism. Therefore, this paper proposes optimization suggestions such as building a systematic curriculum system, strengthening teacher training, and improving the evaluation mechanism, in order to provide theoretical references and practical references for promoting the in-depth integration of traditional Chinese herbal medicine culture in primary school science education.

Science Curriculum Development Grounded in Industrial Culture: Theoretical Implications and Practical Pathways (paper ID: 6)

Wang Qi (Southwest University)

Keywords: Industrial Culture, Science Curriculum, Curriculum Development
Abstract: Chinese industrial culture represents a domain-specific manifestation of socialism with Chinese characteristics within the industrial sector. Educational practices grounded in industrial culture provide an important means of sustaining industrial civilization, strengthening industry–education integration mechanisms, and expanding curricular spaces for teaching and learning. As a central avenue for advancing the national innovation-driven development strategy and cultivating future scientific and technological talent, science education should fully leverage the “broader social classroom” to support curriculum design and enactment. Guided by scenario theory, this study systematically identifies industrial-culture-related curricular resources and develops science curriculum scenarios grounded in industrial culture. It articulates the generative logic of such curricula across seven interrelated dimensions—contextual embedding, knowledge internalization, cognitive development, inquiry-based practice, learner collaboration, assessment and feedback, and cultural immersion—and proposes four developmental pathways for curriculum design: enhancing scientific literacy, reconstructing curricular experiences, innovating pedagogical approaches, and establishing an integrated assessment ecology. The study seeks to inform local science curriculum development and to advance collaborative models of education linking industry, universities, and research institutions.

Nomadic Pastoralism as a Lens for Place-Responsive Science Education: Insights from Mongolia (paper ID: 66)

Shinetsetseg Gerelkhuu (Okayama University), Hiroki Fujii (Okayama University), Batchuluun Yembuu (Mongolian National University of Education), Uranchimeg Getsel (Mongolian National University of Education), Uuriintuya Dembereldorj (Mongolian National University of Education), Khalifatulloh Field'Ardh (Okayama University)

Keywords: Nomadic pastoralism, Place-responsive pedagogy, Science education, Traditional ecological knowledge, Mongolia
Abstract: Science education often overlooks locally grounded ecological knowledge that develops through sustained interaction with landscapes. This presentation explores how nomadic pastoralism in Mongolia can inform place-responsive approaches to inquiry-based science learning. Nomadic pastoralism is characterised by seasonal mobility and continuous engagement with environmental variability. Herding livelihoods require regular observation of pasture conditions, livestock behaviour, weather variability, and water availability. Through these practices, pastoral communities monitor environmental indicators and interpret ecological change as part of everyday life, generating ecological knowledge grounded in long-term interaction with pastoral landscapes. Such forms of environmental engagement mirror several processes associated with scientific inquiry. Observing pasture conditions, comparing seasonal patterns, and interpreting environmental signals involve recognising patterns, relating observations across time, and developing explanations for ecological change. In this sense, nomadic pastoralism offers a pedagogical basis for observation-based inquiry in science education. Drawing on perspectives from place-responsive pedagogy and traditional ecological knowledge, the discussion examines how pastoral environments make ecological processes observable to learners. Mobility across landscapes encourages attention to environmental variation and comparison across seasons, while traditional ecological knowledge provides experience-based explanations of environmental change. In nomadic cultures, environmental knowledge is shaped not only by observation but also by long-term experience, memory of landscapes, and cultural relationships with the land. The Mongolian pastoral context therefore illustrates how science teaching can connect curriculum concepts with students’ lived environmental experiences. This study argues that recognising nomadic ecological knowledge within science education can support inquiry-based learning by strengthening observation skills, contextual reasoning, and deeper environmental understanding among learners.

29 May 2026 | 11:30-12:15

Abstracts of Parallel Session 1

4.1 Student Cognitive Processes & Personal Characteristics [D2-LP-14]

The Relationship between High School Students' Cognitive Processes during Science Problem-Solving Tasks and Their Personal Characteristics (paper ID: 33)

Manami Sano (Hiroshima University), Mikiharu Ishitobi (Hiroshima University), Takuya Matsuura (Hiroshima University)

Keywords: Cognitive processes in science learning, Personal characteristics, High school students
Abstract: While many studies have investigated the relationship between personal characteristics and cognitive process during problem-solving tasks, few have examined this relation in science education using empirical data. This study examines the relationship between high school students' self-reported cognitive processes during science problem-solving tasks and their personal characteristics. A total of 335 tenth-grade students from public high schools participated in this investigation. Participants completed three science problem-solving tasks involving distinct cognitive demands: graph interpretation, qualitative understanding of phenomena, and quantitative calculation. We used a questionnaire to measure four aspects of personal characteristics—learning motivation, beliefs about learning, beliefs about failure, and effort regulation—comprising ten sub-factors. We applied cluster analysis to the self-reported cognitive process data and examined the relationship between the identified clusters and personal characteristics using t-tests and ANOVA. The analysis revealed that clusters with higher frequencies of cognitive processes in the "Solution Search (Stage 1)," "Calculation/Implementation," and "Review" phases exhibited significantly higher "effort adjustment" across all tasks and situations. In contrast, the other personal characteristics exhibited context-dependent patterns. Higher levels of learning goal orientation and semantic understanding orientation were observed only in specific tasks, whereas lower levels of rote recall orientation were found in specific tasks under particular conditions. These findings suggest a correspondence between retrospective cognitive process patterns and their underlying personal characteristics. This research provides practical insights for science teachers to understand students' personal characteristics through their self-reported cognitive processes and to develop adaptive teaching strategies based on these cognitive profiles.

Do Instructional Strategies at the Beginning of a Unit Arouse Students' Interest in Science Lessons? (paper ID: 39)

Kota Hashimoto (Hiroshima University), Takuya Matsuura (Hiroshima University), Mikiharu Ishitobi (Hiroshima University)

Keywords: Science interest, Teacher's intention, Beginning of a Unit, Junior high school science, Cluster analysis
Abstract: Maintaining Japanese junior high school students' interest in science remains a challenge. Although many instructional studies have attempted to enhance this interest, they often treat it as a single, uniform entity, paying limited attention to its diverse qualitative dimensions. To address this issue, this study focuses on the introductory phase of science units, which plays a critical role in fostering students' interest. The purpose of this study is to examine whether the types of interest intended by teachers are actually elicited in students through their introductory instruction. The participants were 86 ninth-grade students and their science teacher at a public junior high school. First, we interviewed the teacher to identify the specific types of interest the teacher aimed to evoke and the learning activities designed to achieve this goal. Then, we administered questionnaires to the students: a pre-lesson survey measuring different types of interest in science learning, and a post-lesson survey to assess the increase in the specific interests targeted by the teacher. The results showed that although the instruction generally increased the targeted interests, a significant disparity emerged among student groups. Using the pre-survey data, we performed a cluster analysis and identified four distinct student groups. ANOVA revealed that students in clusters with higher initial interest in science learning tended to achieve significantly higher scores in the targeted interests. These findings suggest that although introductory instruction effectively triggers specific interests, additional pedagogical support is necessary to engage students with lower initial interest in science learning.

A Survey of High School Students' Perceptions of Physics and Sustainability (paper ID: 52)

Keiya Muramatsu (Okayama University), Koto Yamamoto (Okayama University)

Keywords: Physics education, sustainability, student perception, survey research, high school science
Abstract: This study explores high school students' perceptions of the relationship between physics learning and sustainability. Although physics often attracts students with strong academic interest, its relevance to environmental challenges is not always clearly recognized. Examining students' motivations can inform instructional approaches that make sustainability more visible in physics learning. A questionnaire adapted from a previous study on student attitudes toward physics was administered to second-year physics students at two public high schools in Okayama City, Japan, including both general and science tracks (N = 208). Students rated their interest in physics using a four-point scale and selected reasons for studying physics through multiple-response items. Positive attitudes toward physics were reported by 170 students (81.7%), including 60 students who liked physics (28.8%) and 110 who somewhat liked it (52.9%). Negative perceptions were reported by 38 students (18.3%). Sustainability and environmental contribution were among the least frequently selected motivations, suggesting limited recognition of physics as connected to sustainability. The findings indicate a gap between students' interest in physics and their awareness of sustainability. Going forward, this study will systematically review international literature and case studies from countries with advanced environmental education to identify and organize approaches for integrating ESD into physics education.

29 May 2026 | 11:30-12:15

5.1 Higher-Order & Systems Thinking [D2-LP-10]

From Error to Uncertainty: Shifting to a Probabilistic Framework in Experimental Instruction for the Korea Junior Science Olympiad (paper ID: 35)

Youngseok Jhun (Seoul National University of Education), Hyoung Yong Park (Gyeongin National University of Education)

Keywords: Measurement uncertainty, GUM, Experimental instruction, Probabilistic reasoning, Science Olympiad training, Middle school students
Abstract: The Korea Junior Science Olympiad (KJSO) Committee annually selects and prepares the national team for the International Junior Science Olympiad (IJSO) through a "pre-education, post-selection" system. Students selected through this process undergo intensive experimental training prior to the international competition. This study investigates the experimental instruction provided within this framework, with a specific focus on the conceptualization and treatment of measurement and measurement uncertainty. Moving beyond the conventional frequentist approach typically used in error analysis, we developed a learning program grounded in a probabilistic framework of measurement uncertainty. The program is theoretically informed by the Guide to the Expression of Uncertainty in Measurement (GUM), published by the International Bureau of Weights and Measures (BIPM). The instructional design integrates everyday and scientific contexts to clarify the purpose of measurement, emphasizing the interpretation of results as probabilistic estimates rather than deterministic values. Furthermore, the program provides structured opportunities for students to engage in both qualitative and quantitative reasoning, including the representation, propagation, and interpretation of uncertainty in experimental settings. A pilot implementation was conducted with a small group of students to evaluate learning outcomes and instructional feasibility. The results provide insights for enhancing experimental instruction and assessment practices within Science Olympiad training programs.

Cultivation of Senior High School Students' Systems Thinking about Chemistry-related Socio-scientific Issues (paper ID: 50)

Yan Wu (The University of Hong Kong), Anthony Cheng (Ka Lok Cheng, The University of Hong Kong)

Keywords: Systems Thinking Development, Secondary School Chemistry Education, Mixed Methods Methodology
Abstract: Fostering students' systems thinking (ST) in chemistry helps them understand the interconnections within and beyond the field and prepares them for complex challenges. The use of socio-scientific issues (SSI) in classrooms serves as a vehicle for this kind of development. This study aims to explore how SSI-based learning can foster students' ST development, which will be guided by three research questions: (1) How can socio-scientific issue (SSI) tasks be designed to meet curriculum requirements while simultaneously fostering high school students' systems thinking and subject-matter learning? (2) How is systems thinking manifested by high school students in mainland China through their participation in socio-scientific issue (SSI) tasks? (3) What key factors contribute to the development of systems thinking among high school students in mainland China when engaging in socio-scientific issue (SSI) tasks? The pilot pedagogical interventions, adopting the 5E instructional model, were implemented with 450 participating students. The analysis of mind maps and screen recordings suggested potential development in their ST. The improvement achieved by the experimental class was significantly better than that of the control group, and all core indicators demonstrated significant differences. Data also indicated gains in both knowledge application and thinking ability, alongside increased interest in chemistry. Despite predominantly positive perceptions of AI-supported SSI tasks, students acknowledged encountering difficulties during the learning activities. This study could further the understanding of the potential of AI-empowered classroom interventions for developing students' ST capacities during SSI-based learning.

Climate Change Education in Continuing Professional Development: Evidences from Teacher Workshops in Four Asian Cities (paper ID: 57)

Khalifatulloh Fiel'Ardh (Okayama University), Hiroki Fujii (Okayama University), Ari Widodo (Indonesia University of Education), Munirah Ghazali (Al-Bukhary International University), Jestoni Babia (City College Cagayan de Oro), Sweta Purohit (Centre for Environment Education)

Keywords: Climate Change Education, Continuing Professional Development, International Collaboration
Abstract: This study examined how in-service teachers across four Asian cities conceptualize climate change education (CCE) and plan its classroom implementation. The study was conducted through a collaborative professional development workshop that served as both the research context and intervention. Data were collected from participating teachers （n=105) using a pre- and post-workshop 60-item Likert-scale questionnaire (Cronbach's α = .92), qualitative written responses, and lesson artifacts (Cohen's κ = .72–.81). A ceiling effect was observed for items addressing the general aims of CCE (Q1–7), reflecting strong baseline consensus among participants. In contrast, post-workshop analyses of remaining items (Q8–60) revealed increased skewness, indicating strengthened orientations toward content knowledge, assessment, and pedagogical approaches related to CCE (Mann–Whitney U, $p < .001$). Qualitative findings showed that teachers connected climate science to locally experienced contexts. In Ahmedabad, India (n = 32), teachers integrated anthropogenic explanations with experiential, curriculum-aligned instruction. In Bandung, Indonesia (n = 24), discourse shifted toward mitigation-focused, project-based learning that framed climate change as a human-driven phenomenon. Participants in Cebu, Philippines (n = 20), emphasized interdisciplinary approaches informed by local disaster risks such as typhoons, while participants in Alor Setar, Malaysia (n = 29), increasingly grounded scientific explanations in regional phenomena including haze and extreme heat. Analyses of artifacts (e.g., lesson plan) indicated remaining limitations in the progression toward more transformative forms of CCE. Overall, the results suggest that effective teacher development in CCE lies in supporting context-responsive pedagogical translation rather than reinforcing already shared normative aims.

29 May 2026 | 16:00-16:45

Abstracts of Parallel Session 2

1.2 AI-assisted Text Analysis & Argumentation Assessment [B4-LP-08]

Towards an Interpretive Framework for Comparing the Affordance of AI-Generated Science Texts (paper ID: 25)

Ka Lok Cheng (The University of Hong Kong)

Keywords: AI-supported learning, conceptual learning, university biology, text analytics, photosynthesis

Abstract: Artificial intelligence (AI) could serve as a supplementary learning resource for students‘ science learning. While numerous studies characterise the lexical, grammatical, stylistic, and affective attributes of AI-generated texts, and the conceptual learning effects associated with their use have been documented, relatively few studies focus on the affordances of AI-generated texts to support students' conceptual understanding. The increasing use of AI and the limited study of the science texts it generates mandate a more in-depth textual analysis of its potential for conceptual construction. As a precursor project, the current study limits itself to the topic of photosynthesis at the freshman level and delineates (1) the precursor tools developed for such analysis, which includes systematic text generation, subject-specific pre-processing, and network analytics tools, together with (2) the characterisation of the lexical frameworks derived from the generated texts in terms of their node, cluster and network-level attributes, and (3) the upcoming work on the evaluation and comparison of the generated texts in terms of their affordance to support conceptual understanding through developing concept hierarchies. The current study paves the way for the development of a framework that allows the relative merits of the generated texts in supporting conceptual learning to be interpreted.

An Analysis of Integration: Does That A.I. Detectable? Looking at Some Implementations Through the Lens of Integration Theory (paper ID: 81)

Tomoki Saito (Juntendo University)

Keywords: Theory of integration, coherency, mixed methods, STEM integration

Abstract: This study aimed to apply the lens of integration theory to look at some STEM implementations done under the light of integration. The lens had developed through intensive discussions among international scholars and now defined as students' performances engage with the nature and technologies. When we try to assess student's performances in the context of inquiry, the AI support is inevitable to mutually obtain entire students works in the environment. However, a problem here is the detectability of students work by the language of AI. As the result of analyses, this study shows the boundaries between which we can analyze and assess even after the time of implementations and which we need to discuss through the development of AI tools. Former is based on the pragmatics of students reports, presentations, or teachers reports, so far. The students report in several classes showed that the difference between experienced and novice students who referred to the method part of their activities. Under the lens of integration, the experienced students reported coherent but original terms in general. On the other hand, the novice students tended to refer original but incoherent terms. Later is defined as unknow in our prepared environment. Even in the detectable sphere, students showed unexpected performances that original and some did not refer what they did in the activity part. We present and discuss how we can develop an appropriate support for the students in the era of AI and the expected tool development based on the theory of integration.

A Study on the Impact of Multi-agent System-Based Scientific Argumentation Environment on Pre-service Teachers' Argumentation Abilities (paper ID: 80)

Tingting Li (Henan University), Huijun Wang (Henan University), Shuhui Zhu (Henan University), Zhaojie Hao (Henan University)

Keywords: Pre-service Teacher Education, Empirical Research, Scientific Reasoning, Multi-agent Systems

Abstract: Teachers' scientific argumentation abilities are a key factor influencing the effectiveness of science argumentation instruction. Research indicates that pre-service science teachers (PST) often have limited scientific argumentation abilities. However, intelligent agent environments can provide valuable opportunities to develop these abilities. Scientific argumentation is a complex, multi-dimensional activity that requires balancing logic, dialogue, and knowledge. This study aims to enhance the argumentation abilities of PST by designing differentiated intelligent agent roles based on the multi-dimensional nature of scientific argumentation. Using the Microsoft AutoGen multi-agent framework, we developed a human-agent interaction platform that supports scientific argumentation. The platform features four distinct agent roles-Argument Advocate, Logic Monitor, Knowledge Collaborator, and Interaction Coordinator—each connected to the DeepSeek large language model. PST take on the role of the Argument Advocate and engage in collaborative discussions with other agents to solve scientific problems. This study employed an experimental design to evaluate the potential of the platform in enhancing PST scientific argumentation abilities. A total of 60 participants (Experimental Group=30, Control Group=30), were recruited from X University and randomly assigned to two groups. Both groups were tasked with using either a general large language model or the multi-agent collaboration platform to solve problems. Data collected included interaction logs and scientific argument they built. LDA topic modeling was used to analyze interaction log texts, and the scientific argumentation evaluation framework was applied to assess the argumentation outcomes. The findings showed that (i) the experimental group discussed more topics in the multi-agent environment than the control group; (ii) the argumentation structure presented by the experimental group was more complex, with higher argument quality, featuring more elements such as rebuttals, and excelling in dimensions such as claim clarity and reasoning complexity. The multi-agent system for scientific argumentation developed in this study addresses the limitations of large language models. The empirical research reveals the potential of multi-agent systems in supporting the professional development of pre-service science teachers, fostering their scientific argumentation towards a direction characterized by rigorous structure, in-depth dialogue, and solid evidence.

29 May 2026 | 16:00-16:45

Abstracts of Parallel Session 2

2.2 Science/STEM Identity [D2-LP-07]

Identity of Expert Science Teachers: A Phenomenographic Study in the Chinese Context (paper ID: 15)

Chengshu Luo (University of Macau), Binbin Cai (University of Macau), Xiufeng Liu (University of Macau)

Keywords: Science teacher identity, Chinese context, Phenomenography, Qualitative, Secondary education

Abstract: Science teacher identity has been studied as a crucial factor in the professional development of preservice and novice science teachers, whereas the characteristics of expert science teachers identity remain unexplored in the Chinese context. To address this gap, this study interviewed 34 secondary-level science teachers in China who hold the "senior teacher" title and analysed the interview transcripts using a phenomenographic approach. The preliminary findings showed that there are five potential aspects of identity of expert science teachers, including (1) beliefs and values about science, science teaching, and science education, (2) actions and performances as science teachers, (3) the recognitions and expectations from others, (4) personal experiences as science learners and teachers, and (5) the future self as science teachers. Within each aspect, two or three qualitatively different descriptions of science teacher identity have been identified. In general, all the qualitatively distinct descriptions can be preliminarily categorized into three levels: trainer for testing, teacher for scientific knowledge, and educator for the scientific mindset across the five aspects. Accordingly, this study will establish an outcome space to understand variations in the professional identity of expert science teachers. It will also shed light on potential professional development trajectories of expert science teachers. The findings will have implications for future science teacher training within the context of educational reform in China.

What is STEM Identity? A Phenomenographic Study of Chinese Students in Grades 4-12 (paper ID: 16)

Binbin Cai (University of Macau), Chengshu Luo (University of Macau), Xiufeng Liu (University of Macau)

Keywords: STEM identity, Phenomenography, Qualitative, Elementary and secondary students

Abstract: Despite the growing attention to students' STEM identity in educational research, existing conceptualizations remain theoretically ambiguous and inconsistent. Limited research has examined how students themselves conceptualise integrated STEM identity across schooling stages, particularly within East Asian contexts. To address this gap, this study explores how Chinese students in Grades 4-12 define integrated STEM identity using a phenomenographic approach. Data are currently being collected through open-ended questionnaires from approximately 900 students (around 100 per grade level). Through phenomenographic analysis, qualitatively distinct ways of understanding integrated STEM identity will be identified. For each way of understanding, descriptions of STEM identity will be grouped into categories. Accordingly, stage-specific outcome spaces will be organized to represent the structural variation in students' understandings. Preliminary observations from ongoing data collection suggest that students' conceptions of integrated STEM identity may vary across dimensions, including STEM-related beliefs, values, and interests; STEM experiences; STEM competence and performance; recognition; and STEM future orientation. The final analysis is expected to construct outcome spaces for each educational stage, identify key dimensions of variation, and clarify hierarchically structured categories that capture students' qualitatively different ways of perceiving integrated STEM identity. The findings are expected to refine the conceptual structure of integrated STEM identity by grounding it in students' lived meanings, thereby informing future research and educational practice.

Relationships among Components of Students' Science Identity: A Structural Equation Modeling Study (paper ID: 54)

Chen Zhen (University of Macau), Xiufeng Liu (University of Macau), Mi Shuaishuai (University of Macau)

Keywords: Science identity, Identity theory, Science identity measurement, grade 8 student, quantitative research

Abstract: Despite two decades of intensive research, science identity scholarship remains fragmented due to theoretical inconsistencies, variable conceptual components (e.g., competence, performance, recognition, interest, belonging, and future selves), and incomparable measurements. These issues impede cumulative progress of the field and equitable intervention designs. This study addresses this fragmentation by reconceptualizing science identity through Burke and Stets's (2023) Identity Theory, which frames identity as a dynamic perceptual control system. Drawing on the TIMSS 2023 international database (N = 200,093 eighth-grade students from 28 countries), structural equation modeling was employed to test hypothesized relationships among science identity components grounded in Burke and Stets' identity verification cycle. All seven hypothesized directional paths were positive and statistically significant ($p < .001$). The strongest relationships were from future self to competence belief ($\beta = 0.649$) and from competence belief to interest ($\beta = 0.543$), with a substantial covariance between future self and interest ($r = 0.538$). Feedback loops involving recognition and science engagement were significant but moderate ($\beta s = 0.126–.218$). Anchoring science identity components within Burke and Stets' identity development model, , this study contributes to resolving longstanding theoretical and methodological fragmentation of science identity research by presenting a coherent, valid and reliable model of science identity components for future research on science identity.

29 May 2026 | 16:00-16:45

Abstracts of Parallel Session 2

3.2 Education for Sustainable Development & SSI [D2-LP-13]

Sustainability as a Context for Inquiry-Based Science Education: Design and Outcomes of an ASEAN+3 Student Camp for the Gifted in Science Program (paper ID: 44)

Soo-Young Lee (Seoul National University of Education)

Keywords: Gifted Science Education, Inquiry Competency, Global Competency, Socio-Scientific Issues, Middle School Students, Empirical Research

Abstract: This study examines the design and student outcomes of the 2025 ASEAN+3 Student Camp organized by the ASEAN+3 Center for the Gifted in Science (ACGS). The program was developed for scientifically gifted secondary students across ASEAN Member States, China, Japan, and the Republic of Korea, framing sustainability—particularly food preservation and food security—as an authentic socio-scientific context for advanced inquiry-based science learning. Participants collaborated in cross-national teams to investigate scientific principles underlying traditional and modern food preservation practices. Through hypothesis formulation, experimental design, variable control, microbiological analysis, and data interpretation, students explored interdisciplinary concepts spanning chemistry, biology, environmental science, and physics. The instructional design emphasized high-level reasoning, collaborative inquiry, and culturally contextualized problem-solving appropriate for gifted learners. Program outcomes were evaluated using pre–post measures of scientific inquiry competency and global competency. Statistical analysis indicated significant improvement in both domains. Participant satisfaction exceeded 93 points on a 100-point scale, reflecting strong perceived educational value. In addition, final poster presentations were analyzed using a structured rubric, examining (a) the depth and accuracy of scientific concepts applied, (b) research types employed (e.g., experimental design, comparative investigation, field-based inquiry), and (c) the extent to which projects articulated connections among science, technology, and societal sustainability issues. Results demonstrate that sustainability-driven inquiry provides a rigorous and effective framework for advancing gifted science education.

Towards a more informed decision-making on socio-scientific issues: A modelling-based pedagogical framework (paper ID: 83)

Zeyu Han (The University of Hong Kong), Chen Chen (The University of Hong Kong)

Keywords: Model-based learning, Socio-scientific issues (SSI), Pedagogical framework, Secondary students

Abstract: As the modern goal of science education moves toward cultivating students' functional scientific literacy, science educators expect students to make informed decisions on Socio-scientific Issues (SSIs). Their inherently interdisciplinary nature poses significant challenges for conventional science pedagogy, whereas integrating modelling and SSI shows great potential. Research indicates that the explicit conflict between the scientific and social aspects, and the resulting trade-offs students must navigate, are central to addressing SSI. Yet existing pedagogical frameworks still fall short in highlighting such trade-offs. When students apply existing scientific models (empirical) and socio-scientific models (conceptual) to inform decisions, a significant validity crisis arises due to their different natures, suggesting a fundamental pedagogical dilemma. Theoretically, we argue for a reconceptualisation of the socio-scientific model: a simplified, empirically grounded representation of social phenomena that enables social considerations to be weighed with comparable rigour. Building on this, we develop a new pedagogical framework towards more informed decision-making on SSI, explicitly highlighting the trade-offs. Empirically, following a quasi-experimental design, we investigated and compared how middle school students in experimental and control groups (with or without the newly reconceptualised socio-scientific modelling, respectively) made their decisions on a specific SSI. Using dual-process theories as the analytical lens, we found that, overall, the experimental group uses a more thorough analytical system in their decision-making. They engage more in the counterbalance between scientific and social aspects of the issue and reflect on their personal values more explicitly. Our new pedagogical framework shows strong potential for moving towards more informed decision-making on SSI.

Beyond Universal Principles: Proposing the Science-Validated Ocean Systems Scheme (SV-OSS) to Diagnose Divergent Textbook Enactments of Ocean–Atmosphere Literacy in China's Unified Curriculum (paper ID: 45)

Yupeng Wang (Capital Normal University), Yujing Guo (Capital Normal University) and Xin Bai (Capital Normal University)

Keywords: Ocean Literacy, Textbook Analysis, Middle School Science, Curriculum Enactment

Abstract: Current global ocean literacy frameworks—most notably the UN's Seven Principles—are scientifically robust but decontextualized, limiting their utility in nationally standardized yet regionally implemented curricula. In China, where a unified curriculum mandates core learning outcomes but regional publishers produce distinct science textbooks, ocean–atmosphere systems risk being represented through fragmented, localized lenses. To address this gap,
we propose the Science-Validated Ocean Systems Scheme (SV-OSS): a four-dimensional analytic framework grounded, comprising: (1) Knowledge of the Ocean; (2) Systemic Dynamics; (3) Human–Ocean Co-Constitution; (4) Epistemic Reflexivity. The SV-OSS framework is not a replacement but a contextual expansion of existing literatures in Science Textbook Analysis. We outline a forthcoming comparative content analysis of three nationally approved junior science textbooks using rigorous coding protocols. This work offers a transferable method for diagnosing how national regulations are enacted in local educational contexts.

29 May 2026 | 16:00-16:45

Abstracts of Parallel Session 2

4.2 Science Conceptual Understanding & Misconceptions [D2-LP-14]

Metacognitive Regulation of Teleological and Lamarckian Misconception in Student Explanations of Phenotypic Change (paper ID: 51)

Yaeko Otaka (Okayama University), Khalifatulloh Fiel'Ardh (Okayama University)

Keywords: High School Biology, Evolution, Misconception, Metacognitive Regulation

Abstract: High school students often explain evolution through teleological reasoning (attributing traits to a purpose) or the Lamarckian fallacy (the inheritance of acquired traits). These intuitive frameworks often coexist with scientific concepts, creating a state of "conceptual coexistence" that hinders deep conceptual change. This study investigated whether a metacognitive intervention (centered on self-assessment using rubrics, peer assessment, and structured review) could help students adjust these biases and master the principles of natural selection. Participants were 43 second-year high school biology students from Okayama Prefecture. Students wrote about both phenotypic gain (speed in cheetahs) and phenotypic loss (blindness in cave salamanders) in three phases: before instruction, after textbook instruction, and after metacognitive intervention. During the intervention, students were required to monitor their writing using specific rubrics targeting three scientific elements: variation, heritability, and differential survival. After the intervention, the percentage of students who provided scientifically consistent explanations (explanations that incorporated all three target elements without misunderstandings) increased to 88% (38 students) for trait gains and 74% (32 students) for trait losses. These results indicate that metacognitive self-evaluation effectively facilitates the adjustment of teleological and Lamarckian biases, while misunderstandings remain more persistent in the context of evolutionary loss. These results suggest that metacognitive strategies are essential for overcoming various intuitive hurdles and fostering an autonomous, scientific understanding of biology.

The Significance of Direct Experience with Nature: A Historical Perspective on Approaches in Intuitive Teaching in Japan (paper ID: 55)

Yuya Nakanishi (Niigata University)

Keywords: Primary science education, Minds-on/hands-on learning, Practical work, Intuitive teaching, Object lessons, Japan, Historical research

Abstract: In recent years, practical work is gaining much attention among science educators. Traditionally, Japan has emphasised the importance of practical experience in primary school science education. This approach has been carried forward into secondary schools, where science lessons primarily involve practical observation and experimentation, carried out individually or in groups. The concept of 'intuitive teaching' was first introduced by instructors at the Higher Normal School, including Tanahashi Gentaro, during the Meiji period, when science education was first established. Subsequently, many practitioners explored teaching methods based on direct experience. This research aimed to clarify the theoretical basis of these practices and how they have evolved. A literature review was conducted on intuitive teaching methods from the Meiji period to the early Shōwa era. The findings revealed that the goal was to positively influence children's character development by enabling them to acquire knowledge about the world through their own experiences. Specifically, learning from both tangible objects and cognitive aspects (concrete and abstract dimensions) was emphasised. Meanwhile, the advantages of intuitive teaching in vocational education were emphasised. These findings suggest that the focus was not solely on empiricism or the acquisition of methodology, but also on the importance of engaging in active, reflective thought processes. This historical perspective offers significant insights for the present day, where the proliferation of digital materials and scientific advances often necessitate conceptual learning without tangible experience.

Animal Care in Living Environment Studies: Research Trends on Coexistence between Animals and Humans in Japan (paper ID: 65)

Karen Onodera (Okayama University)

Keywords: Living Environment Studies, Animal Care, Coexistence between Animals and Humans, Research Trends

Abstract: This study aims to clarify research trends regarding animal care in Japanese elementary school Living Environment Studies (LES) from the perspective of coexistence between animals and humans and to suggest future research directions. As LES, a subject designed for lower-grade elementary school children (ages 6–8), seeks to cultivate children's relationships with the natural world through experiential learning, its educational role has become increasingly significant in contemporary society, where pressing challenges such as climate change and biodiversity loss demand new perspectives on sustainable coexistence between animals and humans. In this context, this study conducts a comprehensive review of previous Japanese research on animal care in LES. The findings indicate that, although the number of relevant studies remains limited, coexistence-related themes have been examined in relation to educational aims and objectives, teaching materials, instructional approaches, children's experiences and characteristics, collaboration with external institutions (e.g., zoos), and interdisciplinary connections (e.g., LES and science). Three major characteristics emerge. First, research has expanded beyond respect for life and animal welfare to address biodiversity conservation and environmental sustainability. Second, many studies focus on caring for small wild animals, as well as insects, because of their accessibility and educational suitability. Third, some studies explicitly discuss the perspectives that should be cultivated in lower-grade children, emphasizing that animals and humans inhabit different environments yet live interdependently within the same global ecosystem. Future research should develop theoretical frameworks and practical instructional approaches that systematically foster this perspective across early childhood education and related subjects.

30 May 2026 | 10:00-11:00

Abstracts of Parallel Session 3

1.3 AI Educational Platforms & Self-Directed Learning [D2-LP-08]

Development of an AI-powered EdTech Platform and Teacher Professional Development Package to Promote Primary Students' Self-Directed Learning (paper ID: 24)

Wing Man Poon (The University of Hong Kong), Ka Lok Cheng (The University of Hong Kong)

Keywords: AI-empowered educational technology, Self-directed learning, Design-based approach, Primary education, Teacher professional development

Abstract: This project addresses the challenge of fostering self-directed learning in primary classrooms while managing teacher workload by developing an AI-powered educational technology platform. Grounded in self-regulated learning (SRL) theory and principles of the learning sciences, the platform scaffolds students through the cyclical processes of planning, monitoring, and reflection. The key features of the AI-empowered platform include an "evidence-based practice scheduler" that operationalises retrieval practice and spaced review, alongside various task templates such as worked-example completion items. Furthermore, the platform uses AI to provide automated diagnostic feedback that targets specific reasoning gaps, thereby alleviating teachers' burden of routine marking. Currently, the platform's functional architecture and pedagogical scaffolds have been developed. The study employs mostly a qualitative approach to evaluate usability, pedagogical alignment, and the impact on workload in a local primary school. Data collection involves semi-structured interviews and questionnaire surveys with Primary 3 teachers following a two-week authentic trial. The findings of the above design-based study will be used to develop a teacher professional development (TPD) package that aims to foster teachers' use of AI to support learning in other pedagogical settings. The comprehensive TPD package and findings regarding stakeholder perceptions, focusing on students' SDL behaviours and changes in teacher stress profiles, will be reported. This project offers a scalable model for integrating responsible AI to enhance formative assessment and teaching sustainability in East Asian contexts.

Development and Implementation of an EdTech-Based Ecology Education Program to Enhance Ecological Sensitivity and Digital Literacy (paper ID: 62)

Sumi Jo (Gyeongin National University of Education), Young Joon Shin (Gyeongin National University of Education), Hyoung Yong Park (Gyeongin National University of Education)

Keywords: Edutech, Ecology Education, Ecological Sensitivity, Digital Literacy, Elementary Students

Abstract: This study aimed to develop an EdTech-based ecology education program for elementary school students and to examine its effects on ecological sensitivity and digital literacy, both of which are emphasized in Korea's 2022 Revised National Curriculum. Using the ADDIE instructional design model, the study implemented a 22-session program and employed a quasi-experimental design with 72 second-grade students from a public elementary school in I Metropolitan City. The experimental group (n = 22) participated in the EdTech-based program over 12 weeks, whereas the control group (n = 50) followed the regular curriculum. Results indicated that the experimental group showed a statistically significant increase in overall ecological sensitivity—particularly in the emotional and behavioral subdomains—compared with the control group. In addition, the program significantly improved students' overall digital literacy and practical application skills. These findings suggest that systematically integrating school-forest experiences with digital tools can foster emotional empathy toward nature and promote pro-environmental behaviors. The results also indicate that digital activities, such as creating ecological maps and collaborating via EdTech platforms, effectively strengthen practical literacy by enabling students to explore and reconstruct information based on real-world experiences. In conclusion, this study provides empirical evidence that EdTech-based ecology education is a viable approach to cultivating future core competencies by bridging nature and technology through innovative pedagogical methods. Building on these findings, sustained efforts are needed to promote educational innovation by proactively integrating emerging technologies and digital ecosystems into science curricula to meet future needs.

AI-empowered Project-Based Teaching of "Exploring the Value of Highland Barley, a Characteristic Cereal in Tibetan Regions": Sugar (paper ID: 113)

Min Luo (Guangxi Normal University)

Keywords: AI empowerment, Project-Based Teaching, Highland barley, Sugar, Secondary student, Empirical research

Abstract: The integration of Artificial Intelligence (AI) into subject teaching has attracted widespread attention and discussion in the education sector. However, the accuracy of AI-generated responses still needs improvement, making the cultivation of students' critical thinking a key factor for effective interaction with AI. In chemistry teaching, under the theme "Dialogue with AI: Exploring the Value of Highland Barley, a Characteristic Cereal of Tibetan Regions," students are guided to use AI for information retrieval and to discern the authenticity of information. The teaching focuses on four tasks—"Investigating the Growth Habits of Highland Barley", "Exploring the Energy Supply Mechanism of Tsampa", "Deciphering the Culture of Highland Barley Wine" and "Evaluating the Value of Highland Barley"—to help students learn core knowledge such as the structure, properties, and transformation of sugars. This approach enhances students' independent thinking and experimental innovation skills while also attending to the cultivation of core competencies in chemistry.

30 May 2026 | 10:00-11:00

Abstracts of Parallel Session 3

2.3 Creative Thinking & Problem Solving [D2-LP-10]

Pathways to Scientific Creativity: A Meta-Analytic Structural Equation Modelling of Relationships among Scientific Knowledge, Divergent Thinking, Convergent Thinking, Critical Thinking and Scientific Creativity (paper ID: 30)

Shuaishuai Mi (University of Macau), Xiufeng Liu (University of Macau)

Keywords: Basic education, Meta-analytic structural equation modelling, Scientific creativity, Critical thinking, Divergent thinking, Convergent thinking
Abstract: Understanding pathways to scientific creativity is critically important for assessing and cultivating it. This study employs meta-analytic structural equation modelling (MASEM) to synthesize empirical findings from existing literature and to test the validity of a structural model of scientific creativity. Specifically, we examined the relationships among divergent thinking, convergent thinking, critical thinking, scientific knowledge, and scientific creativity. The results reveal three key insights. First, divergent thinking had only a limited direct association on scientific creativity, whereas convergent thinking showed no significant association with scientific creativity. Second, critical thinking may function as a cognitive regulator that balances the openness of idea generation (divergent thinking) with idea evaluation (convergent thinking), while scientific knowledge serves as a key mediating resource. Third, scientific knowledge plays a central and foundational role in shaping scientific creativity.

Enhancing Fifth Grade Students' Creative Thinking in University Demonstration School Through Sky and Constellations STEAM Learning Activities (paper ID: 61)

Supaluk Srikachin (Srinakharinwirot University), Tepkanya Promkatkeaw (Srinakharinwirot University)

Keywords: STEAM Education, Creative thinking, Skys and Constellations learning unit, Primary education, Mixed-methods research
Abstract: Learning topic of the sky and constellations clearly integrates STEM disciplines. Integrating art as a condition of the problem situation in STEAM learning activities could help students connecting scientific, mathematical, and technological concepts while enhancing their creativity which potentially leading to future innovation. This research aims to study the effects of Sky and Constellations STEAM learning unit on the development of fifth-grade students' creative thinking while participating three activities over a period of 15 hours. Participants were 30 fifth-grade students from a university demonstration elementary school in Bangkok, selected through purposive sampling during the second semester of the 2025 academic year. Data collection involved students' creative thinking pre-test and post-test, student behavior observation, and assessment of students' work from each activity. The findings show that students' creative thinking scores, both overall and in each component, during and after learning were increased. Students had higher levels of fluency, flexibility, and elaboration after learning while originality remained at the same level. The number of students with fair level of creative thinking or higher tended to increase during learning, while the number of students in needs improvement level tended to decrease, both overall and in each component. Students also demonstrated increased creativity in designing and creating artifacts which combined knowledge of science, technology, mathematics, engineering, and art through participating in activities. However, further research on learning methods to promote the components of originality and elaboration for better development is needed.

An Analysis of the Internal Structure of Creative Self-Concept among Secondary School Students: A Physics-Based Survey (paper ID: 18) (Online)

Xinxin Dong (Beijing Normal University)

Keywords: Creative self, Creative mindset, Perceived creative value, Perceived creative potential, Creative self-efficacy, Secondary students, Quantitative survey
Abstract: The development of creative talents is a key focus in global education reform. To understand the fundamental drivers of individual creative growth, the idea of a creative self has become a central topic in creativity research. As a domain-specific self-concept, creative self refers to an individual's perception and evaluation of their own creativity. This study focused on four dimensions of creative self-concept—creative mindset, perceived creative value, perceived creative potential, and creative self-efficacy—and surveyed 340 high school students in the context of physics education. The instrument included the Creative Mindset Scale (CMS), the Beliefs About Creativity Scale (BACS), and the Short Scale for Creative Self (SSCS), collectively forming a five-point Likert scale. The results show that creative mindset, as the independent variable, fully exerts its influence through perceived creative value as the primary mediating variable. Both growth mindset and fixed mindset positively influence perceived creative value. Further analysis shows that perceived creative value not only positively predicts perceived creative potential but also directly enhances creative self-efficacy. Notably, a chain mediation effect was also identified: perceived creative value can further indirectly enhance creative self-efficacy, the outcome variable, through the mediating role of perceived creative potential. Therefore, in fostering individuals' creative self-concept, creativity-oriented teaching should prioritize reshaping students' perception of the value of creativity and cultivating their sense of creative potential. Teaching practices should provide positive reinforcement for students' creative expressions and offer more opportunities for participation in creative learning activities.

30 May 2026 | 10:00-11:00

Abstracts of Parallel Session 3

3.3 STEAM Curriculum Design & Implementation [D2-LP-13]

The Role of Teachers in STEAM Education: A Case Study of Shokuiku (Food and Nutrition Education) in Japan (paper ID: 42)

Tetsuo Isozaki (Hiroshima University), Hirohito Higuchi (Hiroshima University), Takuya Ochi (Seikei University), Takako Isozaki (University of Toyama), Mahiro Nakayama (Hiroshima University)

Keywords: STEAM education, Shokuiku (Food and nutrition education), dialogue, reflection
Abstract: Shokuiku, which refers to food and nutrition education in Japan, can be taught not only by home economics teachers and nutrition teachers but also by science teachers as part of science, technology, engineering, liberal arts, and mathematics (STEAM) education. We integrated shokuiku into secondary science lessons. Based on these results, we highlight the implication. First, because there is no Course of Study for STEAM education in Japan, schools should establish a shared understanding why we offer it to students, and what we hope students will gain from it. Second, STEAM education requires collaboration among teachers of different but related subjects, which involves developing teaching materials through dialogue among teachers, with students and knowledgeable persons beyond the school, while carefully considering students' learning needs. By analyzing lesson plans, students' reports, interviews with the teacher who conducted the lessons, and related materials, we found that one of the factors in effective lessons is structured around real-life contexts that hold significance for students. Providing sufficient time for students to reflect on their learning is essential. Teachers should also carefully review and reflect on students' behavior during lessons and in their reports. We argue that teachers' collegiality is crucial to recontextualize cross-curricular themes–such as shokuiku–specifically through both formal and informal exchanges of information about what students are learning in relation to subjects, and that these exchanges play a vital role in gauging students' readiness. Ultimately, we conclude that the core features of successful STEAM education are dialogue and reflection.

Model Construction and Implementation Path of Cultural Inheritance Comprehensive Practical Activity Curriculum from the Perspective of STEAM Education (paper ID: 58)

Guanyou Shang (South China Normal University), Xinyue Shen (South China Normal University), Yunzhu Wang (South China Normal University), Wenhui Zhao (South China Normal University), Chunyan Feng (South China Normal University)

Keywords: Comprehensive Practical Activities, STEAM Curriculum, Guangdong Culture, Traditional Culture, Cultural inheritance, Secondary student, Empirical study
Abstract: In response to the current problems of monotonous forms, superficial experience, and disconnection with modern science and technology in local cultural inheritance curricula, this study constructs a comprehensive practical activity curriculum that fully embodies traditional Guangdong local culture based on the STEAM education concept. Grounded in the theories of localized, situated and experiential learning, this research forms a curriculum design model of "cultural symbiosis" and establishes a structure of "cultural core—experiential scaffold—innovative activation". The cultural core serves as the value foundation of the curriculum. It goes beyond the transmission of knowledge and emphasizes the philosophical ideas, ethics, aesthetic tastes and collective spirits embedded in culture. The experiential scaffold acts as an important facilitator in cultural inheritance. Innovative activation, which covers innovation in both cultural content and form, is the key to the living inheritance of cultural heritage. It further proposes a four-stage IECP implementation path model for cultural inheritance comprehensive practical activities, namely "Inquiry, Immersive experience, Creation, and Dissemination of achievements". In constructing such curricula, efforts should be made to anchor the cultural ontology and design interdisciplinary problems; integrate community resources to build an educational community; strengthen the inquiry closed loop and highlight scientific and technological innovation; and implement process evaluation to emphasize cultural identity.

Present Human Ecosystem Development for the STEAM Education Movement and What Needed in terms of International Partnership (paper ID: 92)

Yoshisuke Kumano (Shizuoka University / Miyagi University of Education), Naoshi Watanabe (Miyagi University of Education), Shuji Kurebayashi (Shizuoka University)

Keywords: STEAM Education, Informal Education, Project Based Learning, Middle School Level
Abstract: In the case of Japan, movement of STEM Education officially started by The Science and Technology Basic Law of 2016. This law was amended to "The Science, Technology, and Innovation Basic Law of 2021. Under this law, all of the governmental office of Japan has been planning to develop the society towards to the "Society 5.0" which means "a society that is sustainable and resilient against threats and unpredictable and uncertain situations, that ensures the safety and security of the people, and that individual to realize diverse well-being." Following these Japanese STEAM education policies, lots of educational projects starts changing the direction towards future innovation and well-being such as Super Science High Schools, Next Generation Science & Technology Challenge Program, STEAM Library & Future Classroom Project, and so on. In this presentation, the "Exploring-Germination-and-Growth program for young Scientists" and "ZERO-Step STEAM Project" at Tohoku University and Miyagi University of Education from 2023 to 2026 are examined as the case study. For about three years, we have been taking care about 20 to 30 middle school students who developed individual STEAM research and all the students attended interesting STEAM area researches by the university level professors every month. Also, senior mentor and university students' mentors keep communicating with them directory or in-directory through e-learning system so called "Moodle" system. The three years results will summarize. On this line, we will propose the importance of international partnership needed for STEM/STEAM education among Asian Countries.

30 May 2026 | 10:00-11:00

Abstracts of Parallel Session 3

4.3 Attitude towards Science [D2-LP-14]

Development of High School Physics Lessons to Enhance Students' Learning Attitudes —Through Unit-Wide Lesson Design Using a Context-Based Approach— (paper ID: 53)

Koto Yamamoto (Okayama University)

Keywords: High School Physics, Context-Based Approach, Student Attitudes, CLASS

Abstract: Against the background of the issue that Japanese high school students exhibit low interest and enjoyment in learning physics despite possessing internationally high scientific literacy, this study proposed and evaluated a lesson design using a "context-based approach" that connects real-world phenomena with learning content. The study was conducted during a 5-hour unit on "Static Equilibrium" for second-year students at a public high school in Okayama Prefecture. A learning cycle consisting of attempting to solve context-based problems, realizing they cannot be solved with current knowledge, acquiring the necessary knowledge, and answering the problems again was integrated into the overall unit and each lesson. In this research, "context" refers to the treatment of realistic phenomena. "Balancing a carrot," which involves torque and the center of gravity, was set as the overarching problem for the unit. In each lesson, familiar phenomena such as the moment of a doorknob and the center of gravity in the high jump were also set as learning goals. Students' attitudes before and after the intervention were measured using the Colorado Learning Attitudes about Science Survey (CLASS), and paired t-tests were conducted. Analysis of the valid responses (n = 86) showed significant improvements in the overall score and six categories. The improvements in "Real World Connection" and "Personal Interest" were particularly notable. We concluded that effectively positioning problems involving realistic phenomena within the lessons and having students solve them independently helped them understand the connection between physics and the real world, ultimately leading to an increase in personal interest.

Extracurricular Experiences as a Driver for Agency in Pre-Service Science Teacher Education: An Autoethnographic Study (paper ID: 64)

Sena Tanaka (Okayama University), Khalifatulloh Fiel'Ardh (Okayama University)

Keywords: Autoethnography, Education for Sustainable Development, STEAM Education, Teacher Education, Extracurricular Activity

Abstract: This study examines how extracurricular experiences serve as a primary driver for agency among undergraduate pre-service science teachers, investigating how voluntary participation in non-formal settings empowers future educators to navigate and shape their professional identities. Employing an analytic autoethnographic design, the research analyzed experiences occurring between April 2023 and January 2026, utilizing a longitudinal reflective journal as the primary data source to document critical incidents and evolving pedagogical interpretations. To ensure analytical rigor and move beyond personal memoir, data source triangulation was conducted through structured reflective dialogues with a peer and a mentor, facilitating both horizontal validation and vertical theoretical scaffolding. Inductive thematic analysis identified three core drivers of agency: an Education for Sustainable Development (ESD) theme where sustainability-oriented activities connected scientific knowledge with ethical decision-making; an international engagement theme where intercultural collaboration prompted proactive reflection on inclusive communication; and a STEAM theme where creative, design-oriented experiences enabled a transition from curriculum recipient to active designer of inquiry-based learning. The findings suggest that extracurricular participation is a critical catalyst for professional agency, supporting more contextual, inclusive, and flexible approaches to science teaching. By helping pre-service teachers bridge the gap between academic coursework and autonomous instructional practice, these non-formal experiences prove essential for developing the resilience and adaptability required in modern science classrooms.

"Learning while feeling": An exploratory analysis of students' emotional flow in life-value-oriented SSI learning (paper ID: 21) (Online)

Zuotian Qu (Capital Normal University), Yuanhe Zheng (Capital Normal University), Tian Luo (Capital Normal University)

Keywords: Socio-Scientific Issues (SSI), Emotional Dynamics, Life Education, Mixed Methods Research, Secondary Education

Abstract: Emotions are important factors in students' Socio-Scientific Issues (SSI) learning (Sadler & Zeidler, 2005). This study explores the emotional dynamics in a life-value-oriented SSI curriculum, focusing on four themes: Experimental Animals, Pet Euthanasia, End-of-Life Care, and Gene-Edited Babies. The emotional flow of 29 middle school students was tracked via four post-course written self-reports and analyzed using descriptive statistics (e.g., heatmaps, alluvial diagrams) and qualitative interpretation. Results show that emotions generally matched the instructional design, with moral emotions (49.5%, e.g., being moved) dominated the contextualization phase and epistemic emotions (37.6%, e.g., curiosity) peaked during knowledge bridging and discussion. While students' emotional flow was diversified, distinct engagement patterns were identified: Pet Euthanasia and Gene-Edited Babies elicited the highest active engagement, driven by "empathy-dilemma" (conflict between affective resonance and ethical choices) and "curiosity-inquiry" (novelty-driven knowledge construction) pathways, respectively. In contrast, End-of-Life Care evoked strong internal emotion but led to behavioral introversion. Notably, a "non-emotional" state was remarkably common across all themes (39.3%–54.8%). Hence, the results point not only to cognitive load considerations but also to methodological challenges regarding younger students' limited ability to verbalize experienced emotions. These findings highlight the interplay between emotion and cognition, providing evidence for designing differentiated emotional scaffolds.

30 May 2026 | 11:30-12:15

Abstracts of Parallel Session 4

1.4 AI & AR Scaffolding for STEM Design [D2-LP-08]

The Impact of an AI-Enhanced Invention Education Program on Elementary Students' Problem Recognition Ability (paper ID: 63)

Hyeonjin Kim (Gyeongin National University of Education), Hyoung Yong Park (Gyeongin National University of Education)

Keywords: Invention education, AI in education, Problem recognition, Large language models (LLM), STEM education

Abstract: Problem recognition—the ability to notice everyday inconveniences and frame them as opportunities for improvement—is the first and most critical step in invention. However, this competency is often constrained by students' background knowledge. This study examined whether integrating large language models (LLMs) into the problem-recognition phase of elementary invention education enhances students' analytical skills. Thirteen fourth-grade students participated and were assigned to two groups. A crossover design was used to compare LLM-supported instruction with a traditional worksheet-based approach. Students analyzed everyday objects across six dimensions: purpose, structure, shape, size, material, and usage. Data were collected through pre- and post-tests of inventive attitudes, as well as qualitative and quantitative analyses of students' problem-recognition statements using criteria such as elaboration (specificity), originality (novelty), and fluency (divergent thinking). The results indicated that AI-agent–supported instruction significantly improved students' problem recognition abilities. Overall, the findings suggest that AI can function as an effective cognitive scaffold not only for supporting students' idea generation but also for facilitating instructional assessment in invention education.

Harnessing Augmented Reality for Scaffolding Students' STEM Design Practices (paper ID: 103)

Jina Chang (National Institute of Education, Nanyang Technological University)

Keywords: Augmented Reality, Scientific inquiry, Scaffolding, STEM, Design

Abstract: The purpose of this study is to examine how AR can scaffold students' STEM design practices. Adopting a case study approach, the research was conducted in a gifted Grade 5 classroom in Singapore, where 14 students participated in STEM lessons focused on designing and building wind turbines through AR-based inquiry. This study collected multiple sources of data, including classroom video recordings, field notes, and student artifacts. The data were analyzed using multimodal discourse analysis. The findings indicate the three different types of AR-based scaffolding in STEM design processes. First, conceptual scaffolding was enabled by AR as students identified and explored key scientific concepts (e.g., the functions of motor) related to wind turbines through AR-based inquiry. Second, procedural scaffolding was provided in the wind turbine design processes through AR-based interactive three-dimensional observation. The AR-based observation could enhance students' spatial reasoning about wind blades' structures, supporting the efficient design of their own wind blades. Lastly, epistemic scaffolding was afforded before and after the AR activities in promoting evidence-based reasoning. The epistemic scaffolding was implemented with AR-based teacher questioning, peer feedback, and the claim–evidence–reasoning (CER) framework. These three types of scaffolding formed a synergistic system that supported students' engagement in inquiry-driven STEM design practices. Based on the findings, this study suggests that AR can be impactful when its technological affordances are thoughtfully aligned with pedagogical strategies to foster deep and meaningful STEM learning.

Designing an AIGC-Empowered STEAM Curriculum for Local Culture: A Case Study of "Chaoshan Dancong Tea" (paper ID: 46)

Yuxing Li (South China Normal University), Chunyan Feng (South China Normal University)

Keywords: STEAM curriculum AIGC, Local culture, Secondary student, Theoretical research

Abstract: In the era of artificial intelligence, leveraging cutting-edge technology to revitalize traditional culture represents a vital new direction for interdisciplinary integration in STEAM education. However, current science education often struggles to effectively bridge local cultural heritage with modern technological applications. To address this, this study explores and develops an AIGC (Artificial Intelligence Generated Content) empowered interdisciplinary STEAM curriculum framework, utilizing the characteristic Chaoshan Dancong tea as a pedagogical medium. With biology at its core, the curriculum guides students to investigate the physiological characteristics of tea plants and the biochemical principles underlying traditional tea processing techniques. Simultaneously, the curriculum introduces lightweight, user-friendly AIGC tools to facilitate a "cultural maker" experience. Students are instructed to extract local aesthetic symbols—such as Chaozhou woodcarving and the traditional "Xiashanhu" architectural style—to generate innovative tea packaging designs that reflect local cultural identity. Furthermore, students apply mathematical knowledge alongside AIGC assistance to conduct product cost accounting and preliminary market pricing. This study systematically elaborates on the interdisciplinary instructional design path structured around "scientific inquiry, engineering simulation, and cultural maker" activities. Ultimately, this research aims to provide a robust theoretical reference and an operable curriculum development paradigm for implementing localized STEAM education in secondary schools.

30 May 2026 | 11:30-12:15

Abstracts of Parallel Session 4

2.4 Problem solving & Design in STEM education [D2-LP-10]

From Following Instructions to Leading Innovation: A Qualitative Study of Student Agency in STEM Maker Education (paper ID: 122)

Zhihong Wan (The Education University of Hong Kong), Zhaoxi Liu (The Education University of Hong Kong)

Keywords: Student agency, STEM maker education, Secondary education, Qualitative research, Growth mindset, Peer support, Teacher guidance

Abstract: In many STEM classrooms, there is a silent gap between students who simply follow a manual and those who truly take charge of their learning. This study investigates what bridges that gap, exploring the factors that transform passive participants into active "makers." Through 20 in-depth interviews, we identified a developmental pathway for student agency driven by four key dimensions: contextual, material, personal, and interpersonal. The "story" of student agency begins with an entry point: well-designed, challenging activities (contextual) that spark curiosity. As students move from ideas to action, hands-on engagement with physical tools (material) transforms that initial spark into a tangible sense of achievement. To sustain this momentum, a growth mindset and prior interest (personal) provide the internal drive, while peer collaboration and empowering teacher guidance (interpersonal) act as a safety net, scaffolding persistence when projects get tough. Our analysis further reveals how these factors specifically shape six traits of an empowered learner: intentionality, self-reactiveness, persistence, interactivity, self-perception, and choice-making. We conclude that fostering creative explorers requires more than just high-tech gadgets; it demands a systemic "ecosystem" that integrates engaging design, accessible resources, and a supportive social network.

TUnderstanding the Dynamics of Creative Interdisciplinary Problem-Solving in STEM Learning: A Cultural-Historical Activity Theory Study (paper ID: 36)

Yue Chen (University of Macau), Xiufeng Liu (University of Macau)

Keywords: Creative interdisciplinary problem-solving, Cultural-Historical Activity Theory, qualitative, primary and secondary school

Abstract: Creative interdisciplinary problem-solving (CIPS) is a core dimension of STEM literacy. Although essential, current scholarship lacks a clear understanding about the process of CIPS. Specifically, we still don't know specific features of productive CIPS, which hinders formative assessment of STEM learning. To address this gap, this study examines the dynamic process of CIPS through the lens of Engeström's third-generation cultural-historical activity theory (CHAT). The CIPS process is conceptualized as a collective activity system mediated by the interaction of its structural elements. Data sources comprised multimodal artifacts collected from various STEM activities across different grade levels, including worksheets, reports, diagrams, and videos. Following segmentation into meaningful units, data were analyzed using a simultaneous dual-coding strategy: segments were coded independently against CIPS capabilities and CHAT structural elements. Preliminary analysis revealed that students' CIPS capabilities were unevenly distributed among different groups and across different problem-solving stages. Specifically, there was a variation among student groups in cognitive depth regarding tool usage: while some groups remained at the level of identification or routine application, others demonstrated high-level mechanistic reasoning and systemic consideration mediated by conceptual tools. Furthermore, various contradictions have emerged, such as the tension between the innovative use of interdisciplinary tools and the material constraints of the object. These contradictions appeared to drive the problem-solving process. By further analyzing the intersection between these two coding schemes, it is anticipated that this study will uncover key process features and dynamic trajectories of CIPS. Ultimately, this study will provide a theoretical framework to support the ongoing, personalized process-oriented assessment of CIPS.

The Transition of Problem-solving Learning Design in Japanese Elementary School Science Education (paper ID: 71) (Online)

Toshihide Hirano (Aichi University of Education)

Keywords: Problem-solving method, Living skills, Ability to create the culture of future, Elementary school science, Literature research

Abstract: Science education does not simply transmit the culture of objectified natural science. Rather, it aims to realize the purpose of education by engaging children in the process of cultural emergence through problem-solving methods, thereby enabling them to acquire the values inherent in natural science, such as logic, objectivity, rationality, and empirical validity, as living skills, and equipping them with the ability to create the culture of the future." This is the explanation given in the goal statement when problem-solving-based elementary school science education was introduced to Japan in the 1960s. It is difficult to say whether this interpretation has since permeated and survived in elementary school classroom practice. Even today, it can be interpreted as maintaining a view that aims to explore everyday life and develop scientific inquiry skills centered on children's independent problem-solving activities. Meanwhile, the goals of science education have undergone some changes in line with the historical backdrop of Japan's economic transition from a period of high growth to a period of stable growth and then low growth. In addition to tracing this through literature, we will also look at the changes in how learning content is handled to capture the actual learning situation, and show the characteristics of the analysis results, which focus on the key themes of "shortening time," "formalizing activities," and "diversifying values.

30 May 2026 | 11:30-12:15

Abstracts of Parallel Session 4

3.4 Inquiry-Based & Project-Based Learning [D2-LP-13]

Research on the Curriculum Design Path and Implementation Framework of Comprehensive Practical Activities Incorporating Vocational Experiences (paper ID: 48)

Jiaxuan Hu (South China Normal University), Yiying Huang (South China Normal University), Chunyan Feng (South China Normal University)

Keywords: Vocational Experiences, Comprehensive Practical Activities, Design Path, Implementation Framework, Middle school, Theoretical Research

Abstract: In the context of the continuous deepening of educational reform and the vigorous advancement of quality-oriented education, integrating vocational experiences into comprehensive practical activity courses has become a vital approach to connect vocational enlightenment with interdisciplinary educational goals and promote the in-depth integration of science education and vocational education. It carries profound significance for cultivating students' scientific literacy, enhancing their vocational awareness and shaping their practical and innovative abilities. However, the integration process is plagued by prominent problems, including insufficient systematic theoretical guidance and a serious disconnect between curriculum design and practical implementation. Grounded in experiential learning and embodied cognition theory, this study focuses on constructing a systematic practical curriculum design and implementation system. It innovatively proposes the "6I" design path and the "Three-Stage and Six-Step" implementation framework, defines their specific connotations and core tasks at each stage, and provides all-round support from theoretical concepts to practical operation. To verify the system's effectiveness, the study selects three typical STEAM courses: "The Past and Present of Chinese Herbal Tea in Traditional Chinese Medicine", "Agricultural Digital Technician" and "Outstanding Pastry Chef" for case analysis. This research aims to provide referable theoretical support and practical paradigms for the development of vocational experience teaching based on STEAM comprehensive practical activity courses in middle schools.

Understanding Primary Science Teachers' Intentions to Implement Project-Based Learning: Evidence from the Knowledge–Attitude–Behaviour Model (paper ID: 82)

Shuhan Yuan (Beijing Normal University), Yan Dong (Beijing Normal University), Siqi Li (Beijing Normal University)

Keywords: Science Teacher Instructional Practices, Project-Based Learning, KAB Model, Early Childhood and Primary Education, Quantitative Research

Abstract: Project-Based Learning(PBL) is widely recognized as an inquiry-based approach that fosters students' scientific literacy, yet its classroom adoption remains uneven. Prior research has documented the benefits of PBL for teacher professional development (PD) and explored its role in teacher education. However, limited attention has been given to the mechanisms underlying primary science teachers' intentions to implement PBL. To address this gap, this study analyzed survey data from 163 public primary school science teachers. Using t-test and path analysis, we examined teachers' current use of PBL and tested a hypothesized model of factors influencing their intentions, grounded in the Knowledge-Attitude-Behaviour (KAB) model. Results indicate that: (i) teachers generally reported positive attitudes and strong intentions toward PBL use, despite limited self-perceived PBL knowledge. (ii) no significant differences emerged across gender, region, or school type; (iii) perceived PBL knowledge, ease of use, usefulness, attitude, and self-efficacy were all positively associated with implementation intentions; and (iv) perceived PBL knowledge, ease of use, and usefulness indirectly influenced intention through teachers' attitude. By validating this framework, the study clarifies the pathways shaping primary science teachers' intentions to adopt PBL and offers practical guidance for designing targeted PD to support sustained PBL implementation.

Beyond Linear Processes: A Spiral Model for Interdisciplinary Project-Based Learning from a Curriculum Enactment Orientation (paper ID: 84)

Xiang Li (South China Normal University), Qiufen Li (South China Normal University), Chunyan Feng (South China Normal University)

Keywords: Interdisciplinary Project-Based Learning, Generative Orientation, Generative Artificial Intelligence, Secondary Education, Theoretical Study

Abstract: Amid the shift in education from transmission-oriented instruction toward a generative paradigm, interdisciplinary project-based learning (PBL) calls for models that move beyond linear frameworks insufficient for sustaining learners' generative processes. This study introduces the PDIP Generative Design Spiral, a nonlinear design model organized around four interrelated phases: problematization, disciplinary grounding, integrative synthesis, and performative realization. Rather than treating learning as a sequential progression, the model conceptualizes it as a recursive and progressively elaborated cognitive process in which understanding is continually reconstructed through iteration and integration. To address the persistent divide between instructional design and classroom enactment, the spiral incorporates generative artificial intelligence as a cognitive partner and situates learning within a structured support system comprising dynamic scaffolding, collaborative learning communities, and teacher co-inquiry. By aligning design architecture with classroom practice, the model offers a theoretically grounded and operationally coherent framework for re-centering interdisciplinary PBL on the generative development of key competencies.

30 May 2026 | 11:30-12:15

Abstracts of Parallel Session 4

4.4 Science Process Skills & Communication [D2-LP-14]

Science Show as a Learning Platform for Developing Science Process Skills in Upper Secondary Schools (paper ID: 74)

O-Phart Phrathep (Chulalongkorn University)

Keywords: Science process skills, Upper secondary education, Performance-based learning, Scientific explanation

Abstract: This study examines science show activities as a learning platform for developing science process skills among upper secondary school students. The study involved 50 student groups from schools in the central region of Thailand. Data was gathered through observations of performances, analysis of activity reports, and review of assessment rubrics used in the evaluation process. The data collected were analyzed to identify patterns in the design of activities and their contributions to student learning. The findings indicate that most science show presentations focused on chemistry and physics concepts, particularly emphasizing visually engaging phenomena such as color changes, smoke production, and flame reactions. These elements effectively captured audience interest and enhanced student engagement. However, the depth and clarity of scientific explanations varied across groups, with some performances placing greater emphasis on entertainment than on conceptual understanding. The results highlight the potential of the science show activities as a meaningful learning platform to support the development of science process skills, including observation, questioning, hypothesis formulation, scientific communication, and logical reasoning. The study further suggests that the impact of such activities can be strengthened with assessment criteria that balance creativity with conceptual accuracy and scientific explanation. Overall, the findings underscore the role of the science show activities in promoting active engagement and deeper scientific understanding at the upper secondary level.

Assessment System for Science Learning Based on Situational Inquiry (paper ID: 88)

Yangmei Zhong (Srinakharinwirot University)

Keywords: Assessment, scientific literacy, primary science education

Abstract: Scientific learning outcome assessment is critical for enhancing science education and fostering students' scientific literacy. Traditional assessments overemphasize knowledge memorization rather than competency development. This study developed and validated a closed-loop, multidimensional assessment system based on situational inquiry learning, combining quantitative and qualitative tools. The system was implemented among 50 sixth-grade students over one month. It showed strong reliability (Cronbach's α = 0.846–0.943). After intervention, students exhibited significant improvements: scientific concepts (22.52→23.70, $p=0.012$), scientific thinking (15.82→17.82, $p<0.001$), scientific exploration and practice (14.12→20.78, $p<0.001$, 47.17% improvement), and scientific attitudes (88.60→96.44, $p=0.002$). Qualitative results showed that 76% of groups could independently design experiments (vs. 28% pre-intervention), and 82% of students correctly distinguished physical and chemical changes (vs. 45% pre-intervention). This assessment system reliably and comprehensively measures core competencies, providing a valid framework for evidence-based science learning evaluation.

Analysis of Students' Communication Skills in Science Learning Based on Engineering Design Process Stages in Small Group Discussion (paper ID: 47) (Online)

Pramudya Dwi Aristya Putra (University of Jember), Albertus Djoko Lesmono (University of Jember), Devi Yustika (University of Jember)

Keywords: Communication skills, Student's Worksheet, Engineering Design Process, 21st Century Skills

Abstract: Science learning and 21st-century skills form a crucial combination in developing quality human resources capable of addressing various global challenges. One key skill is communication, which enables students to build knowledge through inquiry, planning, and presenting conclusions supported by evidence. This research aims to enhance students' scientific communication skills using the stages of the engineering design process (EDP), a focus that has not been extensively explored in previous studies. This qualitative study adopts a case study approach to assess students' communication skills while solving problems using student worksheets in EDP-based learning. The study involved 12 students—six male and six female—who were in the seventh grade of junior high school, ensuring gender equality in the sample. Data were collected through observation, documentation, and interviews conducted during EDP learning. The data were then reduced and analyzed according to the stages of the EDP and communication skills indicators, followed by drawing inferences from the findings. The results indicate that EDP-based learning facilitates the development of students' scientific communication skills in science education. The stages of the EDP in problem-solving discussions not only expanded students' ideas and solutions but also enabled them to evaluate and revise less-than-ideal solutions through productive discussions, thereby enhancing their communication skills.

30 May 2026 | 14:30-15:30

Abstracts of Parallel Session 5

1.5 Student Epistemic Interaction with AI [D2-LP-08]

GenAI-Driven Instructional Paths for A-STEM in Secondary School Biology (paper ID: 59)

Yunzhu Wang (South China Normal University), Guanyou Shang (South China Normal University), Xinyue Shen (South China Normal University), Wenhui Zhao (South China Normal University), Chunyan Feng (South China Normal University)

Keywords: A-STEM, GenAI, Artistic Literacy, Secondary School Biology, Qualitative Research
Abstract: Against the backdrop of the comprehensive implementation of the ”Aesthetic Education Immersion“ action in China, this paper explores a new instructional path driven by Generative Artificial Intelligence (GenAI) to address the dilemma of superficial art integration in secondary school biology A-STEM teaching. Grounded in Bloom’s Taxonomy of Educational Objectives, this path constructs three spiral-ascending stages:First is the Observation and Reproduction stage, which utilizes GenAI for the ”artistic visualization“ of biological microstructures or invisible scenes to reinforce lower-order cognition.Second is the Deconstruction and Recombination stage, which guides students to extract key biological concepts and underlying logic, achieving knowledge transfer through GenAI-conceived bionic and cross-boundary designs.Finally, the Creation and Evaluation stage supports students in constructing future ecological scenarios and engaging in higher-order critical inquiry of the outcomes from the dual dimensions of scientific logic and bioethics.In terms of implementation strategies, students‘ artistic creativity and scientific literacy can be effectively enhanced through multi-role driving, prompt engineering, and critical discussions. This path, complemented by a multi-dimensional teaching evaluation framework, aims to use GenAI as a bridge to address the marginalization of artistic elements in A-STEM teaching practices and the passivity of technology in traditional STEAM education. Ultimately, it seeks to build an arts-led A-STEM curriculum to cultivate students’ comprehensive literacy and critical thinking.

From Tool to Peer: Cognitive Risks and Tiered Collaboration in AI-Enabled Primary Science Classrooms (paper ID: 89)

Dongping Fan (South China Normal University), Lili Li (South China Normal University)

Keywords: Artificial Intelligence (AI), Early Childhood Education and Primary Education, Cognitive Offloading, Human-AI Collaboration, Nature of Science (NOS), Mixed Methods Research
Abstract: As artificial intelligence (AI) evolves from an assistive instructional tool into a cognitive learning peer within K-12 educational settings, this human-AI relationship both delivers transformative empowerment to primary science education and carries inherent cognitive risks that may hinder students’ higher-order thinking and core literacy development. Grounded in distributed cognition theory, this study systematically examines key phenomena including cognitive offloading triggered by the integration of AI into primary science classrooms, and emphasizes that upholding core student-centered educational goals is the fundamental prerequisite for any responsible and ethical AI intervention in formal classroom teaching. This study further constructs a tiered human-AI collaboration framework to support teachers in designing graded student-AI collaborative learning activities informed by the established view of the Nature of Science (NOS), and proposes a classroom potential risk management model that delineates clear boundaries of cognitive responsibility across two core dimensions: students’ task mastery and AI system stability. Through the in-depth analysis of three practical teaching cases, this study demonstrates that the proposed tiered framework can effectively optimize the instructional design and implementation processes of AI-integrated primary science education. While ensuring students’ sustained and active cognitive engagement throughout the learning process, the framework significantly enhances students’ collaborative problem-solving skills, critical thinking, design thinking, and in-depth understanding of the Nature of Science.

Middle School Students’ Epistemic Vigilance in Co-Constructing Scientific Explanations with Generative AI (paper ID: 105) (Online)

Sally Gutierez (Universiti Sains Malaysia)

Keywords: Epistemic vigilance, scientific explanations, student-GenAI collaboration
Abstract: This study examines middle school students’ practice of epistemic vigilance while co-constructing scientific explanations with generative AI (GenAI). Using a qualitative design, we documented and analyzed eight students with prior experience using GenAI tools (Canva, ChatGPT) during lessons on plant growth and fungi classification. To support their epistemic vigilance, the four criteria of good scientific explanations: relevance, conceptual framework, causality, and appropriate level of representation, were used as explicit epistemic scaffolds to evaluate their co-constructed outputs with the GenAI. Data included transcribed and translated video recordings, student-generated digital artifacts, and semi-structured interviews, analyzed through a multi-layered framework. Findings indicate that students primarily applied content evaluation, scrutinizing conceptual accuracy, causal relationships, and coherence. During source evaluation, they engaged in refining prompts to assess the GenAI credibility, while during receiver evaluation, they reflected on their personal understanding and negotiation with peers. The study concludes that explicit epistemic criteria enable students to critically evaluate content, interrogate source reliability, and reflect on their interpretation skills, thereby fostering evaluative judgment. Recommendations include integrating epistemic scaffolds in GenAI-supported science learning, positioning GenAI as a collaborative partner rather than an authoritative source, and embedding reflective prompts to recognize biases and varied interpretations. Future research should explore long-term development of epistemic vigilance and whether these skills transfer across contexts. The study is limited with small sample and short-term classroom interactions. Despite these, the study provides valuable insights into leveraging explicit epistemic criteria to enhance critical engagement with GenAI, supporting rigorous scientific reasoning and responsible AI use in classrooms.

30 May 2026 | 14:30-15:30

Abstracts of Parallel Session 5

2.5 Interdisciplinary Competence & STEM Literacy [D2-LP-10]

Review of Interdisciplinary Competence (paper ID: 43)

Yiying Huang (South China Normal University), Jiaxuan Hu (South China Normal University), Xiang Li (South China Normal University), Zhe Zhou (South China Normal University), Chunyan Feng (South China Normal University)

Keywords: STEAM Education, Interdisciplinary, Competence Systematic, Literature review, Secondary student

Abstract: Students' interdisciplinary competence is particularly crucial for addressing global challenges nowadays. This study employs a systematic literature review to examine research from 2021 to 2025 on the conceptualization, core dimensions and assessments of interdisciplinary competence in educational settings with a specific focus on its cultivation within and implications for STEAM education contexts. The literature reveals that while interdisciplinary competence—the ability to integrate knowledge, thinking and practices from multiple disciplines is central to solving complex real-world problems, its assessment faces persistent challenges. Notably, within STEAM education, assessment tools often lack sufficient disciplinary contextualization and fail to capture the dynamic, integrative thinking processes essential for innovation. Moreover, there is a pronounced gap in articulating assessment across primary to tertiary educational stages. Based on these findings, this paper proposes key future directions for research and practice: (1) develop assessment tools grounded in specific disciplinary practices to enhance contextual validity within STEAM projects; (2) construct a progressive assessment model that bridges different educational stages; and critically, (3) explore the application of Generative Artificial Intelligence (GenAI) in empowering process-oriented assessment. The study highlights how leveraging GenAI, particularly for automated analysis of project reports and discussion records, can address the "black hole" in evaluating the dynamic learning process, thereby offering a novel pathway to translate the theoretical goal of interdisciplinary competence into actionable, large-scale assessment within AI-enhanced STEAM education frameworks.

Breaking the Dilemma and Reconstructing the Curriculum: An Experimental Study on the Reform of Psychology Research Methods Course Empowered by the STEAM Concept (paper ID: 97)

Xiaoli Zhang (Guangxi Normal University)

Keywords: STEAM concept, pre-service teacher training, curriculum reform, empirical research, university

Abstract: Currently, psychology research methods courses in local undergraduate normal universities are confronted with three core dilemmas: deviation from talent cultivation objectives, fragmentation of teaching logic, and alienation of curriculum evaluation from students' development. Taking SPSS Basics and Statistics as the experimental carrier, this study introduced the STEAM (Science, Technology, Engineering, Arts, Mathematics) education concept, and constructed and implemented a four-in-one teaching reform scheme covering "objectives-content-teaching-evaluation". A one-semester quasi-experimental study was conducted among psychology majors in a provincial normal university. The results indicated that the reform effectively improved the data science literacy of students in the experimental group, with particularly significant improvements in engineering practice literacy and artistic expression literacy. Qualitative analysis revealed that project-based learning facilitated the cultivation of research thinking and the formation of research identity among pre-service teachers. This study provides an operable scheme for the curriculum reform of psychology majors, explores an innovative path for cultivating "research-oriented teachers" in normal universities, and holds important theoretical and practical significance for promoting the connotative development of teacher education.

Study on the Recognition of Competency Models of the STEM Human Resources Community Influences on Majors : Focus on Higher Education Students in Japan and Thailand (paper ID: 87)

Tomotaka Kuroda (Tama University / Shizuoka University)

Keywords: Higher Education, STEM Education, Competency Model

Abstract: The growing advancement of artificial intelligence and related technologies has further heightened the importance of developing scientific and technological human resources. This trend is not limited to Asian countries such as Japan and Thailand, but has become a global priority and societal need. This study examined how university students majoring in Science, Technology, Engineering, and Mathematics (STEM) in Japan and Thailand perceive the competencies expected of STEM professionals, and how their academic disciplines influence their awareness and perceptions of related challenges. Specifically, I analyzed responses to survey items assessing the perceived importance of 21 competency elements for careers as STEM professionals. These elements were extracted from Japanese policy documents, including the "Fundamental Competencies for Working Persons" compiled by the Ministry of Economy, Trade and Industry, as well as relevant documents issued by the Cabinet Office and the Ministry of Education, Culture, Sports, Science and Technology in Japan. Differences among academic majors were examined using analysis of variance (ANOVA). Significant differences were identified in four of the 21 competency items (Leadership, Communication, Ability to Listen Closely and Carefully, Ability to Control Stress), with students majoring in mathematics and physics tending to rate the importance of certain competencies lower than students in other fields. These findings suggest that academic major should be carefully considered as a key factor shaping students' perceptions of required skill sets. Future research should expand the sample size and incorporate qualitative interviews to further explore disciplinary influences.

30 May 2026 | 14:30-15:30

Abstracts of Parallel Session 5

3.5 Textbook & Material Content Analysis [D2-LP-13]

Treatment of Climate Change Content in Science Education in Indian Compulsory Education: An Analysis of NCERT Textbooks (paper ID: 31)

Ken Kawai (Okayama University), Hiroki Fujii (Okayama University)

Keywords: Climate Change Education, Education for Sustainable Development, India, Compulsory Education, Analysis of NCERT Textbook, Qualitative Research
Abstract: Climate change is a global challenge that has serious impacts on human society, and the role of education in promoting mitigation and adaptation has been emphasized. In India, environmental education was made compulsory by a Supreme Court judgment in 2003, and environmental education, including climate change, has been positioned as a cross-cutting theme within the school curriculum. This study aims to clarify how climate change content is addressed in India by analyzing science textbooks and textbooks including science-related content used at the compulsory education level. The textbooks were examined from five perspectives: (1) causes, (2) impacts, (3) mitigation, (4) adaptation, and (5) behavioral change, and the findings were compared with the National Curriculum Framework 2023 (NCF 2023). The results indicate that at the primary level, "The World Around Us" emphasizes attitude formation rooted in everyday experiences, while at the lower secondary level, "Science" introduces scientific causal relationships and international frameworks, demonstrating progressive deepening. At the same time, several issues were identified, including delayed introduction of concepts, inconsistencies in causal explanations, weak connections to behavioral change, insufficient interdisciplinary integration, and a lack of spiral development of concepts. These findings suggest that future textbook development should incorporate a longitudinal design that repeatedly addresses the same causal relationships across grade levels and should introduce content and learning activities that integrate scientific elements with local community-based examples in order to strengthen connections to behavioral change and interdisciplinary understanding.

Rika (science education) Competencies in the Japan's Course of Study : Analyzing the Discussions in the Rika Working Group in the 2017 Revision (paper ID: 69)

Hiroaki Okada (Hiroshima University), Junye Gao (Hiroshima University), Tetsuo Isozaki (Hiroshima University)

Keywords: Research competencies, rika, Course of Study
Abstract: In the PISA 2025 Science framework, a global science competency framework, the emergence of scientific identity and other developments prompt a reconsideration of the attitudes and values fostered through science education. Ahead of Japan's 2030 Course of Study (CoS) revision, it is necessary to reconsider competency in rika (science education) by clarifying how it was defined during the 2017 revision. This study mainly analyzes the discussions on "competency" within the rika working group (RWG) during the 2017 revision of CoS to elucidate how the components of competencies were altered from the initial debates to the final documentation. The analysis of the RWG materials and the finalized CoS for rika highlights two significant issues as following: First, regarding the competency pillar of "Humanity and Attitudes," early RWG sessions debated diverse elements specified to science, such as "awe of nature" and "scientific ethics". However, the final CoS for rika converged these concepts into the "proactivity," described as the willingness to proactively engage in the problem-solving and inquiry. Second, "Rika's perspectives and ways of thinking" shifted from an instructional goal to a methodological tool used to acquire competencies. This instrumentalization caused the target competency to be described as abstract, generalized skills (e.g., broad problem-solving abilities) rather than usual scientific perspectives. In light of international trends, it is necessary to discuss competencies in greater depth and reconsidering the ideal student profile to be cultivated in science education during the next revision.

Research Landscape of Scientists' Engagement in K-12 Science Education: A Bibliometric and Content Analysis (paper ID: 67)

Minyi Liu (Beijing Normal University), Jin Shen (Beijing Normal University), Rui Wei (Beijing Normal University)

Keywords: Scientists' Engagement, K-12 Science Education, Bibliometric Analysis, Content Analysis, K-12 Students, Review Study
Abstract: The role of scientists in K-12 science education cannot be overlooked. Adopting bibliometric and content analysis, this study examines 626 studies on scientists' participation in K-12 science education indexed in the Web of Science Core Collection and Scopus, with CiteSpace as the analytical tool. Keyword cluster analysis identifies 17 core clusters covering educational contexts, disciplinary practices, engagement modes, effectiveness evaluation, etc. Results from keyword timezone analysis and burst detection indicate that research hotspots are shifting from disciplinary specialization and practical implementation to a focus on effectiveness evaluation and cutting-edge interdisciplinary integration. Analysis of reference and cited author show that the domain remains relatively fragmented, with characteristics of practicality and interdisciplinarity, while also exposing the underdeveloped theoretical foundation of the domain. Furthermore, through content analysis, this study categorizes the modes of scientists' engagement, identifying 12 direct and 6 indirect forms of participation. In summary, we propose that future research should focus on establishing long-term participation mechanisms for scientists and developing multi-dimensional evaluation systems. Meanwhile, in-depth exploration should be conducted to investigate the micro-mechanisms of intervention, shifting from static, descriptive research to dynamic, process-oriented qualitative research, so as to uncover the black-box in interaction. This study provides crucial insights for understanding the current landscape and developmental trends of research on scientists' engagement in K-12 science education.

30 May 2026 | 14:30-15:30

4.5 Teacher Design Capacity & Planning Tools [D2-LP-14]

Enhancing Biology Teachers' Pedagogical Design Capacity Through an Inquiry-Focused Planning Tool (paper ID: 8)

Nga Yung Yiu (The University of Hong Kong)

Keywords: Scientific inquiry, Pedagogical design, Pedagogical content knowledge, Technological pedagogical content knowledge, Design-based research

Abstract: Scientific inquiry is fundamental for developing students' scientific literacy and epistemic skills. However, secondary biology teachers often find it difficult to turn abstract inquiry principles into specific, topic-focused lesson plans within high-stakes, exam-driven settings. This gap emphasises the urgent need for practical, context-aware tools to improve teachers' ability to design effective pedagogy. This study aims to co-design and repeatedly improve an inquiry-based planning tool within a design-based research framework. The artefact combines Content Representation prompts with concept mapping to display and organise complex pedagogical reasoning, thereby enhancing teachers' capacity to think pedagogically in scientific inquiry. The design is based on three key conjectures: First, making instructional decision-making explicit improves Pedagogical Content Knowledge, which turns collaborative planning into a process of developing professional reasoning; second, mapping processes support the coherent integration of content, pedagogy, and technology by helping teachers visualise and examine the relationships among these areas; third, repeated use of the planning tool encourages professional learning through cycles of reflection-on-action. The research is ongoing, and the next immediate steps involve collecting professional reasoning and teacher perceptions regarding the prototype's usability. These insights will guide refinements for future implementation among senior secondary biology teachers. The potential curricular and pedagogical significance of the tool, along with the use of a design-based approach in its development, will also be discussed in the presentation.

Enhancing Teachers' Scientific Inquiry Pedagogy and Global Perspectives through a Cross-National Teacher Workshop: Evidence from ASEAN+3 Gifted Science Teachers (paper ID: 70)

Sung Hee Lee (Seoul Gyenam Elementary School), Soo-Young Lee (Seoul National University of Education)

Keywords: Gifted Science Education, Sustainable Development of Education, Teacher Professional Development, Qualitative Study, Middle School Science Teachers

Abstract: This study explores the implementation process and perceived benefits of the 2025 ASEAN+3 Teacher Workshop organized by the ASEAN+3 Center for the Gifted in Science (ACGS), with a focus on teachers' professional development. The workshop was designed to strengthen teachers' scientific inquiry pedagogy and global perspectives through cross-national collaboration. Participating teachers shared country-specific instructional practices for gifted science education and engaged in collaborative discussions and seminars, inquiry activities using the DaVinci Science Box, and guided science museum experiences. These activities aimed to enhance instructional professionalism in gifted science education within culturally diverse contexts. Data was collected through interviews and reflective questionnaires from participating teachers and analyzed qualitatively. The findings indicate that the workshop deepened teachers' professional understanding of inquiry-based gifted science instruction, supported the development of global competency-oriented perspectives, and promoted positive professional feedback through the formation of an international teacher network. These results suggest that sustainability-themed global teacher workshops can serve as an effective program for strengthening teacher professionalism in gifted science education across diverse national contexts.

Latent Growth of Elementary Science Teachers' Epistemic Orientation with the Curve-of-factors Model (paper ID: 23) (Online)

Chenchen Ding (Zhejiang Normal University), Gavin Fulmer (Datakind), Lesa Hoffman (Clemson University), Brian Hand (University of Iowa), Jee Suh (University of Alabama)

Keywords: Epistemic orientation, Elementary science teachers, Quantitative, The curve-of-factors model

Abstract: Elementary science teachers participated in a two-year professional development workshop to learn how to use epistemic tools in science classrooms for meaningful learning. Teachers' epistemic orientation was examined on four occasions with a short form of epistemic orientation survey (EOS-SF). The survey includes 32 items with four dimensions: knowledge replication, knowledge construction, epistemic nature of knowledge, and classroom authority. The data came from 148 elementary teachers from public schools in 32 midwestern and southeastern US districts. The years of teaching experience ranged from 1 to 32 years (mean = 14, SD = 8). Participants completed the survey through online platform Qualtrics at four time points. Data were analyzed with the curve-of-factors model (CFM), which examined the change trajectory of the latent variable epistemic orientation across time. The CFM had two levels of factor. First, the measurement invariance of the first-order factors was obtained, which indicated that the survey measured the same latent variable of epistemic orientation over time. Second, the growth model for the second-order factors was achieved with partial residual variance invariance model, which indicated that elementary science teachers' epistemic orientation grew over time. The finding of growth in teachers' epistemic orientation may imply that the workshops for elementary teachers to learn epistemic tools contributed to a shift in teachers' epistemic orientation.

30 May 2026 | 16:00-17:00

Abstracts of Parallel Session 6

1.6 Technology Integration in Teacher Education [D2-LP-08]

Generative AI–Supported Multimodal Composing in a Teaching Methods Course: Insights from Preservice Science Teachers (paper ID: 12)

Song Xue (Zhejiang Normal University)

Keywords: Preservice science teachers, Multimodal composing, Generative AI, Human–AI collaboration, Qualitative research
Abstract: Opportunities for preservice science teachers (PSTs) to engage in sustained processes of idea generation and expression are often constrained by the transient nature of classroom discourse and reliance on single-mode representations. This limitation hinders the development of capacities for scientific expression and explanation and underscores the need for instructional contexts that support ongoing meaning making. Drawing on a multimodal composing and human–AI collaborative perspective, this study integrates a generative AI–supported voice interaction platform into a chemistry teaching methods course to support PSTs' multimodal composing through spoken language, dialogic interaction, and real-time feedback. A semester-long instructional intervention was implemented, focusing on PSTs' composing processes and perspectives(n=40) within this human–AI–supported multimodal learning environment. Qualitative data were collected through questionnaires and analyses of classroom-generated speech transcripts to examine how PSTs perceived and experienced multimodal composing and how these processes shaped their classroom participation and professional thinking. The findings indicate that generative AI–supported multimodal composing enhanced the continuity and visibility of PSTs' idea generation, expression, and response, and fostered greater engagement and reflective awareness. Participants generally viewed this approach as supportive of their transition from learning chemistry content to developing pedagogical reasoning for teaching chemistry. This study offers course-level insights into how generative AI can support multimodal composing in preservice science teacher education.

Technology Empowerment in Teacher Education: Model Construction and Practical Strategies for Developing Teachers' AI Literacy (paper ID: 56)

Qiufen Li (South China Normal University), Guohao Huang (South China Normal University), Xiang Li (South China Normal University), Chunyan Feng (South China Normal University)

Keywords: Artificial Intelligence, Teachers' AI Application Competency, Teacher Professional Literacy, Teacher Professional Development
Abstract: The rapid advancement of Artificial Intelligence is reshaping the educational ecosystem, shifting the requirements for teachers' AI competency from "technological assistance" to "human-machine collaboration." Grounded in the new demands of the AI era and drawing upon teacher literacy development models from UNESCO, South Korea, and Singapore, this study integrates the Stages of Concern, Teacher Development Stages, and Adaptive Expertise theory to construct an "Adaptation-Leadership" model for teacher AI literacy development, consisting of four stages: Adaptation and Exploration, Internalization and Application, Innovation and Reconstruction, and Leadership and Radiation. First, the Adaptation and Exploration stage focuses on fundamental technical applications and the establishment of ethical boundaries; by mastering basic AI tool operations—such as grading assignments and data collection—teachers transition from passive acceptance to active application. Next, the Internalization and Application stage emphasizes optimizing instructional workflows through data-driven approaches, such as AI-assisted lesson planning and learning situation analysis. Subsequently, the Innovation and Reconstruction stage utilizes intelligent agents to reconstruct curricula and establish process-oriented evaluations, driving the innovation of pedagogical paradigms. Finally, the Leadership and Radiation stage marks a leap from individual practice to ecosystem leadership; by formulating systems and developing standards to influence peers, schools, and regions, teachers transform from technology users into leaders of educational reform. To promote the implementation of this model, it is essential to develop evidence-based self-diagnosis mechanisms, create stage-based technical resource packages, construct a full-cycle stepped training system and optimize a data-driven regional development ecosystem, thereby empowering teachers toward actively leading educational transformation.

From Novice to Competent: A Grounded Theory Analysis of Difficulties and Strategies in In-service Kindergarten Teachers' STEAM Professional Development (paper ID: 106)

Wenchao Zhang (Guangxi Normal University), Yuanyuan Gu (Guangxi Normal University), Chang Liu (Guangxi Normal University)

Keywords: In-service Kindergarten Teacher, Teacher Development, Grounded Theory Approach
Abstract: With the advancement of STEAM education in early childhood settings, kindergarten teachers face the practical challenge of transitioning from traditional roles to competent STEAM educators. This study employs a grounded theory approach to explore the difficulties encountered by in-service kindergarten teachers during their STEAM professional development and the coping strategies they adopt. In-depth interviews were conducted with eight kindergarten teachers, and the data were analyzed through open coding, axial coding, and selective coding following grounded theory procedures. The findings reveal that teachers experience multiple difficulties across three dimensions: cognitively, they struggle with comprehending STEAM philosophy and integrating interdisciplinary knowledge; practically, they face challenges in curriculum design, implementation, and resource acquisition; environmentally, they encounter insufficient institutional support and parental cooperation pressures. In response, teachers adopt diverse coping strategies, including proactive self-directed learning, engagement in collaborative research, participation in professional learning communities, peer observation and discussion, reflective practice, and seeking expert guidance. The study conceptualizes the STEAM teacher development process as a dynamic trajectory from novice to competent, characterized by continuous negotiation between internal agency and external support systems. These findings contribute to a deeper understanding of kindergarten teachers' professional growth in STEAM education and offer practical implications for designing targeted professional development programs and support mechanisms.

30 May 2026 | 16:00-17:00

Abstracts of Parallel Session 6

2.6 Career Expectation & After-school STEM Activities [D2-LP-10]

IThe Impact of After-School STEM Activities on Primary School Students' STEM Career Intentions (paper ID: 100)

Jiaru Lv (Beijing Normal University, Zhuhai), Yajing Gu (Beijing Normal University, Zhuhai), Qi Zhang (Beijing Normal University, Zhuhai), Siqi Li (Beijing Normal University)

Keywords: STEM Career Intentions, After-school STEM Activities, Career Education, Science Interest, Primary Education, Quantitative research

Abstract: STEM education is widely recognized as a critical driver of national competitiveness. While previous studies have documented its potential to foster students' academic performance and career interests, limited attention has been paid to the impact of after-school STEM activities on primary students' STEM career intentions, particularly within the Chinese educational context. To address this gap, this study developed a theoretical framework and a pedagogical design model that integrate early career education into after-school STEM programs. Based on this model, an exemplary module titled "The Botanist" was designed. Subsequently, a quasi-experimental study will be conducted in a primary school to evaluate its effectiveness in improving students' scientific inquiry skills, thereby further promoting their science interests and STEM career intentions. Ultimately, this study offers practical guidance for the development and implementation of after-school STEM activities. Theoretically, it broadens the application of Social Cognitive Career Theory (SCCT) within informal learning settings and bridges the gap in primary-level career education. Practically, it serves as a contextualized model for high-quality after-school services under China's "Double Reduction" policy, providing interdisciplinary instructional scaffolding for teachers without career planning expertise.

An overview of applications and trends of science inquiry for learning effectiveness: an umbrella review (paper ID: 123)

Shuo Shan (Beijing Normal University, Zhuhai), Yang Yang (Beijing Normal University)

Keywords: Science inquiry, Science education, Umbrella review, Academic achievement, Science process skills, Critical thinking, Primary and secondary students

Abstract: Over the past decade, Science Inquiry (SI) has been widely promoted as a pedagogical approach to enhance science education; however, the overall effectiveness of SI and the conditions that influence its implementation remain unclear due to the fragmentation of evidence across numerous primary studies and systematic reviews. To address this gap, this study adopts an umbrella review approach to systematically synthesize meta-analyses and systematic reviews published in international journals between 2014 and 2025. A total of 63 eligible studies are expected to be included, covering evidence from dozens of countries, tens of thousands of students, and diverse educational contexts. The anticipated findings suggest that SI will demonstrate highly significant effect sizes on learning outcomes, with expected effects on academic achievement, science process skills, and critical thinking. Additionally, four moderating variables—subject areas, educational levels, teaching methods, and technology integration—are expected to significantly influence the application effectiveness of science inquiry. Based on these synthesized results, this study will propose future application trends for SI in educational practice.

Assessing biology career-related outcome expectations and exploring their predicting effect on students' career-related choices (paper ID: 37) (Online)

Yueling Sun (The Third Experimental Middle School of Taiyuan City), Hanyu Wu (Capital Normal University), Tian Luo (Capital Normal University)

Keywords: Secondary school, mixed methods research, outcome expectations, career interest, subject interest, willingness to choose subject

Abstract: Students' positive attitudes towards careers in disciplinary sciences are important learning outcomes. While numerous studies indicate that outcome expectations are a significant predictor of career-related choices, there is a lack of measuring instrument regarding career-related outcome expectations in disciplinary sciences, such as biology. Moreover, it is essential to explore how different dimensions of outcome expectations impact students' career-related choices such as willingness to choose biology. We developed an Biological Career-related Outcome Expectancy Scale through semi-structured interview, expert review, student interviews, and survey investigation. Reliability and confirmatory factor analysis was conducted to validate the survey using data from 562 first-year high school students. Logistic regression modeling were then performed to examine the effects of gender, biology subject interest, career interest, and career-related outcome expectations on students' willingness to choose biology. The results show that male students' level of entity outcome expectations is significantly higher than that of female students. Students with willingness to choose biology have significantly higher levels of outcome expectations, career interest, and subject interest than those without such willingness. Logistic regression result showed that subject interest and career interest significantly and positively predict students' willingness to choose biology, while career-related outcome expectations significantly and negatively predict this willingness. The negative predictive effect of career-related outcome expectations may stem from students with lower expectations holding more realistic views of biology careers. Research demonstrates the significant yet unexpected role of career-related outcome expectations in shaping students' career-related choices.

30 May 2026 | 16:00-17:00

Abstracts of Parallel Session 6

3.6 Preservice Teacher Cognition & Professional Identity [D2-LP-13]

Right, Wrong… or Something More? Examining Thai Preservice Science Teachers' Perceptions of Noticing Students' Responses (paper ID: 20)

Witchayada Nawanidbumrung (Chulalongkorn University)

Keywords: Inclusive Science Teaching, Perceptions, Preservice Teachers, Noticing
Abstract: Students' responses can be understood as expressions of their reasoning, experiences, and developing understanding, rather than merely indicators of correctness. Inclusive science classrooms, therefore, require more than helping students develop scientific understandings; they require science teachers to attend closely to students' ideas, recognize diverse ways of knowing, and respond instructionally to support meaningful participation for all students. Because teachers' interpretations shape instructional decisions across phases of science teaching, their perceived importance of examining students' understandings is central to inclusive practice. To inform the design of inclusivity-oriented science teacher preparation, this study examined the perceptions of 47 Thai preservice science teachers regarding noticing student understanding. Survey data collected via open-ended questions were analyzed using thematic analysis to identify patterns in how participants perceive and use students' answers as learning evidence. Findings indicate that participants generally viewed students' responses as windows that help the teachers understand students' reasoning and conceptual development. Participants attended to multiple forms of learning evidence, including verbal explanations, written work, and behavioral expressions. Although incomplete or incorrect answers were often seen as productive opportunities for science learning, most participants showed uncertainty in identifying and interpreting partial or evolving understanding, and then translating these interpretations into responsive instructional action. These findings highlight the need for more explicit preparation to help preservice science teachers use student thinking as a foundation for enacting inclusive science teaching.

An Exploratory Study on Preservice Chemistry Teachers' Designing ESD-STEM Lesson Plans connecting Confucianism (paper ID: 85)

Baoyu Li (Shanghai Normal University), Kexin Wu (Shanghai Normal University), Boya Wang (Shanghai Normal University)

Keywords: STEM education, Lesson plan design, Chemistry education for sustainable development, Qualitative tertiary student
Abstract: As STEM education continues to gain prominence globally, integrating local and cultural perspectives has been recognized as a promising approach to advance Education for Sustainable Development (ESD). This exploratory study investigates Chinese preservice chemistry teachers' perceptions of STEM-ESD infused with Confucianism. Eighty-one chemistry student teachers (the fourth semester, aged 20-21) from a Chinese normal university participated in a 32-period reflective teaching design course in 2025. Guided by theories of STEM-ESD education, they collaboratively and reflectively developed ESD-STEM chemistry lesson plans incorporating Confucianism in a step-by-step manner. Twenty-two lesson plans were created across diverse topics, including ancient Chinese smelting, ink making, papermaking, vinegar brewing, fireworks, dyeing, tea, ancient glutinous rice lime mortar, etc. Feedback questionnaires revealed that most student teachers believed that Confucianism-informed STEM-ESD education ought to be integrated into the Chinese secondary chemistry curriculum, and they recognized the cultural and practical values of the ESD instructional model. They expressed positive attitudes toward the course's teaching approach, which enhanced their understanding of ESD while strengthening their cultural confidence, as well as improving their teaching competence and creative thinking—findings consistent with lesson plan assessments and student reflections. However, participants reported challenges in integrating the three core components (STEM, ESD, and Confucianism) into chemistry lesson design. Constraints such as limited class time, students' academic levels, heavy workload, and insufficient school support may hinder their future implementation of such instruction. Overall, this study preliminarily demonstrates that Confucianism-oriented STEM-ESD exerts a positive impact on preservice chemistry teachers.

Exploring the Development of Pre-service Science Teachers' Professional Identity in Science Museums: A Case Study (paper ID: 99)

Yajing Gu (Beijing Normal University, Zhuhai), Qi Zhang (Beijing Normal University, Zhuhai), Ruiqi Yu (Beijing Normal University, Zhuhai), Yang Yang (Beijing Normal University)

Keywords: Informal Science Education, Science Museums, Professional Identity, Pre-service Science Teachers, Case Study
Abstract: Informal science education (ISE) is an essential component of science education, and science museums, as fundamental and critical ISE environments, have powerful education potential. Previous research has documented the benefits of ISE for student learning and science teacher professional development (PD), but limited attention has been given to how science museums influence the professional growth of pre-service science teachers (PSTs). This study employs a case study design to explore how PSTs' professional identity develops during a science museum-based PD program and to identify their experiences that influence the development. Data were collected during the three-month PD program. Through qualitative content analysis of participants' field trip memo, group project, and interview transcripts, the study analyzes the impact of experiences, such as field trips, collaborative project design, and interactions with experts, on the PSTs' science teacher identity development. The results provide empirical evidence for the effectiveness of science museum-based professional development in constructing pre-service science teachers' professional identity and clarify the underlying mechanisms. The findings also offer practical guidance for the design of future science museum activities and teacher professional development programs.

30 May 2026 | 16:00-17:00

Abstracts of Parallel Session 6

4.6 Assessment Methods & Tool Development [D2-LP-14]

Construction of the Assessment Framework for the View of Life Information in High School Biology (paper ID: 60)

Zhe Zhou (South China Normal University), Yiying Huang (South China Normal University), Xinyue Shen (South China Normal University), Xiang Li (South China Normal University), Chunyan Feng (South China Normal University)

Keywords: The view of life information, Assessment framework, High school students, Theoretical research
Abstract: Biology core literacy is the fundamental purpose of the biology curriculum in Chinese middle school. Among them, the concept of life occupies the top position in biology core literacy and best demonstrates the essence and characteristics of biology. The view of life information is an important part of the concept of life, not only helping students deeply understand that life is a unified entity of matter, energy and information, but also enabling students to explain biological phenomena from the perspective of information transmission, and further guiding life practice. Through the review of existing research, it is found that the current assessment frameworks related to the view of life information are mainly constructed based on the essence and connotation of the view, and rarely consider the cognitive development process of students' concept formation. This study, based on the review of relevant literature, uses the Delphi method and analytic hierarchy process, combined with the "Shannon-Weaver" information transmission model and the cognitive path model of the concept of life, has constructed a assessment framework for the view of life information in high school biology, including four primary indicators: information ontology identification, information transmission analysis, information overall insight, and deep philosophical reflection on information, as well as their eleven subordinate secondary indicators. This framework provides a basis for teachers to diagnose the formation stage and level of students' view of life information and determine the key points and difficulties in the process of cultivating the view of life information.

Comparing Paper-and-Pencil and Computer-Based Assessments in Science: Evidence from Grades 5–8 (paper ID: 101)

Ruiqi Yu (Beijing Normal University, Zhuhai), Jiaru Lv (Beijing Normal University, Zhuhai), Yang Yang (Beijing Normal University), Yafeng Zheng (Beijing Normal University, Zhuhai)

Keywords: Computer-based testing, Paper-and-pencil testing, Science education, Test equivalence, Elementary and secondary school students, Quantitative research
Abstract: Computer-based testing has been established as a significant alternative to traditional paper-and-pencil testing in educational assessment. However, existing research presents divergent conclusions regarding the equivalence of these two testing modes. Most studies focus on specific stages of students, lacking comparative research across multiple grade levels. Also, not many studies focused on science disciplines. To address these research gaps, this study recruited 561 students in grade 5 to 8 from South-East China. Participants completed science tests and questionnaires in both computer-based and paper-and-pencil testing environments. Using descriptive statistics and independent samples t-tests, this study compares differences in students' science test scores and questionnaire responses across the two testing modes. It further conducts subgroup comparisons by grade level, gender, and socioeconomic status to examine whether performance varies across these groups under different assessment formats. This study aims to clarify whether the Test Mode Effect exists in science assessment and how this effect varies with demographic characteristics. The anticipated findings will provide empirical evidence for the rational and effective use of computer-based assessment in science education, and raise awareness of potential test mode effects among science teachers and institutions to support targeted preparation and decision-making.

Developing Teaching Competence Indicators for Clinical Psychologists under CBME: A Delphi-Based Research in Progress (paper ID: 38) (Online)

Zhi-Yue Gao (National Dong Hwa University)

Keywords: Competency-based medical education, Clinical psychologists, Teaching competence, Interprofessional education, Faculty development, Literature Review
Abstract: Background: Competency-based reform has redefined teaching in health professions education as a formal, assessable professional capability grounded in observable outcomes and structured evaluation. Within interprofessional learning environments, clinical psychologists increasingly contribute to communication training, psychosocial formulation, reflective practice, and professional identity development. Despite their functional importance, existing educator competency frameworks remain largely physician-centered, creating a structural misalignment in which psychologists' pedagogical contributions are insufficiently represented in formal assessment and faculty development systems. Methods: This research-in-progress study builds on a completed integrative thematic synthesis that examined conceptual tensions across competency-based education, professional psychology training, and interprofessional education. Findings from this synthesis informed the design of a multi-round Delphi consensus process aimed at constructing profession-specific teaching competence indicators for clinical psychologists working in competency-based medical education contexts. Results (Preliminary): Preliminary analysis identified three structural gaps: (1) existing milestone architectures inadequately capture reflective-relational pedagogical expertise; (2) supervision-based models from psychology lack operational alignment with competency-based assessment systems; and (3) current educator assessment tools demonstrate limited construct clarity and insufficient behavioral anchoring for psychologists' teaching roles. Conclusions: The findings suggest that construct reconstruction, rather than instrument refinement alone, is necessary. The ongoing Delphi study seeks to develop context-sensitive competence domains that enhance institutional recognition, informed self-assessment, and cross-professional coherence in competency-based educational reform.

30 May 2026 | 17:00-17:30

Abstracts of Parallel Session 7

1.7 Generative AI-Assisted Assessment of Scientific Literacy [D2-LP-08]

Generative AI for Assessing and Facilitating Elementary Students' Epistemic Understanding of Scientific Inquiry (paper ID: 104)

Jina Chang (National Institute of Education, Nanyang Technological University), Jisun Park (Ewha Womans University), Ju Yeon Sim (Ewha Womans University)

Keywords: Generative Artificial Intelligence, Scientific inquiry, VASI, Assessment, Feedback

Abstract: Most studies exploring the use of generative artificial intelligence (GenAI) in assessment have primarily focused on evaluating students' conceptual understanding or logical reasoning processes. In comparison, relatively little attention has been given to how GenAI can support the epistemic aspects of learning, such as students' understanding of the nature of scientific inquiry. This study investigates the potential of GenAI to facilitate elementary students' epistemic understanding in scientific inquiry. Using the Views About Scientific Inquiry for Elementary Students (VASI-E) instrument, we collected 560 written responses in Korea. A series of prompt strategies was implemented using ChatGPT-4o to develop prompts for automated scoring and feedback aligned with established epistemic frameworks. Student responses were scored as naive, mixed, or informed by GenAI, and the GenAI scores were compared with those of a human rater. The results showed high agreement (κ = .825), with item-level kappa values ranging from .606 to .923. GenAI-generated feedback was also analyzed using three learner-centered feedback criteria: future impact, sensemaking, and student agency. Overall, the feedback was rated as appropriate (average score = 2.75/3), particularly in promoting student agency through personalized and reflective guidance. Some linguistic limitations in Korean phrasing occasionally affected clarity. The findings suggest that, when carefully designed and prompted, GenAI can provide learner-centered feedback that supports students' epistemic understanding of scientific inquiry and offers new possibilities for formative assessment and teacher education.

Feasibility of Automatically Assessing Junior High School Students' Chemistry Argumentation Level Using Large Language Models ——A Comparison Based on GPT-4.5 and DeepSeek-R1 (paper ID: 108)

Haihang Lan (Zhongshan Memorial Middle School)

Keywords: Large language model, scientific argumentation, automatic scoring, chemistry education, quantitative, Secondary student

Abstract: The evaluation of scientific argumentation ability is a key link in argumentative teaching, but manual scoring is time-consuming, labor-intensive, and difficult to scale. Using 220 written argumentative texts generated by 44 ninth-grade students in five argumentative activities in the "Carbon and Carbon Oxides" unit as a sample, and based on a three-level evaluation scheme of "claims only – complete arguments with claims and evidence – rebuttals," the consistency between automatic and manual scoring of two large language models, GPT-4.5 and DeepSeek-R1, was compared. The results showed that: (1) GPT-4.5 had an overall accuracy of 92.7% and a Cohen's Kappa of 0.88, close to the inter-rater reliability of manual scoring (κ=0.92); (2) DeepSeek-R1 had an accuracy of 86.4% and a κ of 0.78, reaching a "highly consistent" level; (3) both models performed best on complete arguments with rebuttals, but had relatively lower recognition rates on texts containing only claims. Large language models have certain feasibility in the automatic scoring of argumentative texts in junior high school chemistry and can be used as a formative assessment tool for argumentative teaching.

30 May 2026 | 17:00-17:30

Abstracts of Parallel Session 7

2.7 Review of Emerging Issues in Science Education [D2-LP-10]

Translating Frontier "AI-Chemist" Achievements into Science Curricula: Bridging Classical and Contemporary Scientific Practices (paper ID: 40)

Chenglin Miao (Beijing Normal University), Jin Shen (Beijing Normal University), Rui Wei (Beijing Normal University)
Keywords: AI Chemist, Creative Problem Solving, Frontier Achievements, Scientists, Mixed Methods Research, Empirical Research, Secondary School Students

Abstract: Artificial intelligence (AI) is propelling science research towards a paradigm of self-driving laboratories. Enabling high school students to personally experience, in authentic contexts, how AI empowers scientific research constitutes an educational response to this transformation. The University of Science and Technology of China (USTC) hosts a world-leading "AI Chemist" laboratory, which possesses autonomous and automated capabilities of designing and executing full-process, high-throughput chemical experiments. The teaching case centers on chemical reaction rates, guiding students into the authentic, historically and contemporarily integrated problem-solving process: historically, chemists Guldberg, Waage, and Arrhenius addressed the effects of concentration, temperature, and catalysts on reaction rates; modernly, the "AI Chemist" optimizes catalysts and reaction temperatures for plastic degradation. By applying the principles discovered by their predecessors to understand cutting-edge research, students gain an appreciation for the continuity and innovation within science. During the curriculum, students confront authentic scientific problems, reconstruct the practical workflow of scientists, formulate their own problem-solving approaches, participate in hands-on research at the laboratory, and engage in dialogue with scientists. The curriculum's effectiveness was evaluated using pre- and post-tests, classroom discourse analysis, and student interviews. The results indicate that students recognized that current AI can independently carry out full-process research, that past and present research are inseparably linked, that scientists constitute a community, and that scientific creation is the result of the cumulative wisdom and effort passed down across generations. Furthermore, students' creative problem-solving abilities improved, and their enthusiasm for creation and scientific aspirations were stimulated.

Fuel Chemistry and Sustainability in the Context of Brunei Darussalam: A Teacher's Autoethnography (paper ID: 86)

Siti Jurainah Junaidi (Okayama University), Khalifatulloh Fiel'Ardh (Okayama University)

Keywords: Chemistry education, sustainability, autoethnography, fuels and energy, secondary education, qualitative research

Abstract: This autoethnographic study draws on eight years of secondary science teaching experience in Brunei Darussalam, where economic life is closely linked to oil and gas production. Within this context, the study adopts a pragmatic pedagogical lens that prioritises classroom feasibility and responsiveness to students' lived experiences. Teaching sustainability here involves navigating a tension between present economic dependence on fossil fuels and preparing students for a future that may rely less on them. Data from teaching journals and classroom artefacts are used to examine how sustainability can be meaningfully integrated into everyday science teaching. Within the Cambridge secondary chemistry curriculum, fuels and energy provide a concrete entry point for exploring resource finiteness as a scientific principle. Concepts such as hydrocarbon structure, fractional distillation, combustion efficiency, and incomplete combustion highlight the limited nature of fossil fuel reserves and the constraints of chemical energy systems. Links to bond enthalpy and the carbon cycle further emphasise that energy production operates within finite material flows. Sustainability therefore emerges not as an external social agenda, but as a logical extension of chemical reasoning grounded in resource limitation. Rather than framing sustainability as a critique of national development, the study positions it as preparation for resilience and adaptation. Inquiry-based learning and real-world problem solving support students in engaging critically with environmental challenges and considering their roles in shaping more sustainable futures.

30 May 2026 | 17:00-17:30

Abstracts of Parallel Session 7

3.7 Teacher Beliefs, Orientation & Reflection [D2-LP-13]

Multifaceted Influences of Instructional Practices on Intentions to Foster Higher-order Thinking Skills: A Comparison of Japanese and Filipino Junior High School Science Teachers (paper ID: 78)

Mikiharu Ishitobi (Hiroshima University), Takuya Matsuura (Hiroshima University)

Keywords: Junior high school science teachers, Quantitative research, Inquiry-based practice, Dialogic instruction, Critical thinking, Metacognition, International comparison

Abstract: Fostering higher-order thinking skills, such as critical thinking (CT) and metacognition, is a primary objective in science education. While instructional practices are expected to promote these skills, the multifaceted influences of teaching practices on teacher intentions may be shaped by specific educational contexts and school environments. This study surveyed junior high school science teachers from Japan (n = 110) and the Philippines (n = 89) to investigate how three instructional factors—Inquiry-based, Dialogic, and Resource-related—affect their intentions to cultivate CT and metacognition. Descriptive statistics revealed that Filipino teachers reported significantly higher overall scores for both practices and intentions than Japanese teachers ($d > 1.4$). A multi-group path analysis showed an excellent fit to the data (CFI = 1.000, RMSEA = 0.000), revealing distinct patterns of influence in each country. For Japanese teachers, inquiry-based practices showed a marginal trend in predicting the intention to cultivate CT ($\beta = .19$, $p = .052$), whereas dialogic instruction was the primary predictor for metacognition ($\beta = .31$, $p < .01$). In contrast, for Filipino teachers, dialogic instruction served as the primary driver for cultivating CT ($\beta = .31$, $p < .01$). Furthermore, teaching experience was negatively associated with intentions to foster CT in both countries ($p < .05$), suggesting that early-career teachers may prioritize fostering higher-order thinking more than their senior counterparts. These results suggest that the associations between instructional practices and teacher intentions are context-dependent, highlighting the necessity of considering specific educational environments and frameworks in comparative studies of teacher perceptions.

Instructional Approaches to Foster Higher-Order Thinking in Lower Secondary Science Classrooms: A Qualitative Analysis of Teachers' Practices (paper ID: 114)

Takuya Matsuura (Hiroshima University)

Keywords: Instruction, Metacognition, Critical thinking, Inquiry-based learning, Qualitative analysis

Abstract: Recent reforms in science education have increasingly emphasized the development of students' higher-order thinking skills, including metacognition and critical thinking, particularly within inquiry-oriented science learning (e.g., Zimmerman, 2002; Kuhn, 2010). In addition, the role of argumentation and reasoning as central practices in science classrooms has been widely discussed (Osborne, 2014). Despite these theoretical advances, there remains a need to better understand how science teachers actually foster higher-order thinking skills through their everyday instructional practices. This study aims to examine instructional approaches employed by lower secondary science teachers to support students' higher-order thinking skills during science lessons. Specifically, the study explores how teachers facilitate students' reasoning, critical thinking, and metacognition in inquiry-based learning contexts. Data were collected through an online questionnaire survey of lower secondary science teachers in Japan. A total of 110 teachers provided open-ended descriptions of their classroom practices related to fostering metacognitive awareness, critical thinking, and inquiry-based problem solving. The responses were analyzed using inductive qualitative content analysis to identify recurring patterns and categories of instructional approaches. The study seeks to develop a typology of teachers' practices illustrating how different forms of instructional scaffolding function to promote students' higher-order thinking skills. Preliminary analysis suggests that although many teachers expressed an intention to foster metacognition and critical thinking, their descriptions of instructional practices were often general or activity-oriented rather than cognitively explicit. This indicates a potential gap between theoretical constructs and their pedagogical operationalization in classroom contexts. The findings highlight the importance of clarifying how higher-order thinking can be translated into concrete instructional scaffolding within inquiry-based science teaching.

30 May 2026 | 17:00-17:30

Abstracts of Parallel Session 7

4.7 Teacher Professional Development Models & Pathways [D1-LP-14]

Exploring the Journey of Science Teachers' Adaptive Expertise Development in Educational Technology Integration: Focusing on Threshold Practices (paper ID: 27)

Heesoo Ha (Pusan National University), Seungho Maeng (Seoul National University of Education), Phil Seok Oh (Gyeongin National University of Education), Jin-Ju Pyo (Seoul National University)

Keywords: Adaptive expertise, threshold practice, educational technology, educational technology integration

Abstract: While the rapid influx of emerging technologies has swamped schools, the lack of a systematic approach often confines teachers to a reactive state of chasing technological trends. This study addresses this challenge by characterizing science teachers' professional efforts to integrate technologies through the lens of adaptive expertise—the teacher competence of purposefully leveraging digital resources to achieve transformative pedagogical goals, transcending mere technical mastery or the simple addition of tools to existing instruction. Using this perspective, this study aims to examine science teachers' development of adaptive expertise by identifying threshold practices—transformative milestones, that teachers experience, navigate, and learn to evolve their instructional practices. To achieve this goal, we first conducted reviews of literature on science teachers' technology integration. By synthesizing these reviews, we identified a set of hypothetical threshold practices in science teachers' technology integration. These initial findings were then empirically verified and refined through semi-structured interviews with science teachers who are experienced in technology-enhanced instruction. The analysis illustrates key threshold practices that serve as "gateways" to high-level adaptive expertise. We further detail how teachers navigate these thresholds to evolve and transform their instructional practices. This study provides a foundational understanding of the professional growth pathways for science teachers, offering insights into supporting their adaptive expertise in an increasingly technology-driven educational reforms.

Bridging Policy and the Science Classroom: A Pilot Study of a Teachers' Professional Development Program on Generative AI Adoption in the Philippines (paper ID: 29)

Lowell Gabunilas (University of Science and Technology of Southern Philippines), Rolando Obiedo (University of San Carlos)

Keywords: Artificial Intelligence in Education, Generative AI, Technology Adoption, Science Education, Professional Development

Abstract: A key strategic task in the Philippine National AI Strategy Roadmap 2.0 for an AI-ready future is to transform education and nurture future AI talents. With regards to science education, this necessitates effectively integrating AI into the teaching and learning environments. To address the gap between national initiatives and the science classroom practice, a targeted professional development (PD) program was designed to equip science teachers with the skills to utilize generative AI. Developed using the ADDIE instructional design model, the PD's content and structure were grounded in the Unified Theory of Acceptance and Use of Technology (UTAUT) and adult learning theory. The PD was piloted among science teachers from various schools and evaluated using Guskey's 5 Levels of Evaluation. Results demonstrated highly positive ratings across all evaluated subscales: Teacher Reaction (M = 4.85, SD = 0.11), Teacher Learning (M = 4.85, SD = 0.09), Classroom Practice (M = 4.49, SD = 0.09), Student Learning (M = 4.56, SD = 0.12), and Organizational Support (M = 4.28, SD = 0.25). Moreover, post-implementation classroom observations revealed that AI-integrated lessons designed by the program participants significantly increased student engagement and collaboration which reinforces the program's consequential validity. Enhancing institutional support for teachers' technology utilization and adopting policies that promote the effective and ethical use of AI in schools are recommended. For future iterations, refining the program for high replicability and resource efficiency across diverse settings, and balancing contextual adaptability with strict fidelity of implementation must be considered.

29 May 2026 | 11:30-12:15

Abstracts of Greater Bay Area Science Education Forum 1

大湾区科学教育论坛 1 [B4-LP-08]

报告1： 国防科技后备人才培养模式的困境与突破——基于人的全面发展理论的路径探索 (216)
作者: 王映
报告摘要： 立德树人是教育的根本任务。当前，在全面加强全民国防教育与科学教育的政策导向下，中学阶段国防科技后备人才培养仍面临价值引领浅表化、素养培育碎片化、发展路径断层化三大现实问题，严重制约兼具家国情怀与创新能力的后备人才成长。本文基于马克思主义“人的全面发展”理论，深入剖析上述问题的本质根源，指出其关键在于教育实践中价值、能力与志业三者的系统性割裂。研究提出，应构建“价值塑造—能力锻造—志业引领”三位一体的育人体系，并通过“理念铸魂—课程赋能—路径贯通—机制护航”四大路径，推动国防科技后备人才培养中个人成长与国家战略的深度融合，为基础教育阶段落实“为党育人、为国育才”使命提供理论依据与实践参考。 党的二十大报告明确指出：“教育、科技、人才是全面建设社会主义现代化国家的基础性、战略性支撑。”这一论断深刻揭示了人才自主培养在国家现代化建设中的核心地位。《新时代爱国主义教育实施纲要》《关于加强和改进新时代全民国防教育工作的意见》等文件的密集出台，进一步凸显了培养胸怀家国、敢于创新的国防科技后备人才的紧迫性。然而，政策愿景在基层落地过程中，仍普遍存在“最后一公里”落实难题。不少学校的实践探索停留于形式化、表浅化的活动堆砌，未能触及育人机制的核心，导致国防科技教育陷入“有形式无内涵、有知识无体系、有起点无延续”的困境，难以有效支撑国家战略人才储备的长远需求。 面对这一现实挑战，有必要回归教育理论的本源进行反思。马克思主义“人的全面发展”理论强调，人的发展应是社会性、能力性与个体性的有机统一，涵盖体力、智力、道德与个性等多维度的充分、和谐与持续发展。该理论为审视当前国防科技后备人才培养中的价值脱节、能力割裂与路径断裂问题提供了关键的分析视角。本文以此理论为基础，系统诊断中学阶段国防科技教育中存在的典型误区，深入阐释其理论根源，并尝试构建一个以“三位一体”为特征、理论与实践深度融合的育人模式，旨在探索一条符合时代要求、遵循教育规律的国防科技后备人才培养新路径。

报告2： STEM理念下的初中“生物+”跨学科教学实践——以“校园生态地图”为例 (214)
作者: 张琴, 王华征
报告摘要：《义务教育课程方案（2022 年版）》明确提出开展“跨学科主题学习”，培养学生综合运用知识解决实际问题的能力。针对当前初中阶段跨学科教学存在的学科壁垒明显、知识整合浅表化、探究过程断裂等问题，本文基于STEM 教育理念，以“北斗绘校园生态地图”项目为载体，设计了一套融合生物、地理、数学、信息技术的“生物+”跨学科课程。以校园生态优化为真实情境，开展生态调查、数据分析与方案设计，探索STEM 理念在“生物+ ”跨学科教学中的整合逻辑与实施路径，为推动初中生物课程转型与学生核心素养提升提供可行范式。

报告3： STEAM教育中工程思维的培养路径探索与实践——以『电磁弹射器』项目(222)
作者: 姜传星, 姚海霞, 展兴海, 段杉杉
报告摘要： 针对当前学校科技课程中普遍存在的“重制作结果、轻思维过程”问题，以“电磁弹射器”制作为载体，探索在STEAM教育中系统培养学生的工程思维。研究从工程思维的核心要素出发，设计了包含“需求分析与问题界定—方案设计与详细决策—原型实现、测试与诊断—优化迭代与最终评价”全流程的项目式学习活动，并通过追踪学生在关键决策点的思维过程，分析了工程思维在真实问题情境中的发生机制。实践表明，基于真实工程问题的STEAM项目能有效引导学生建立“权衡思维”、“系统思维”、“迭代思维”和“约束思维”等工程思维方式，为中小学STEAM课程落实工程教育目标提供了可操作的实践路径。

报告4： 指向高阶思维发展的科学教育分层进阶模式构建(223) (Online)
作者: 黄炳超，董一名，沈姝含
报告摘要： 世界的竞争归根结底是人才竞争，科学教育是国家科技创新人才培养和全民科学素质提升的基础性工程。人工智能技术迅猛发展正在重塑教育生态，新的科学知识和技术不断涌现，多重挑战制约科学教育范式变革。科学教育分层进阶模式以布鲁姆认知分层理论为基础，按照认知复杂性和抽象程度分为认知层、应用层和创新层，以认知层为基础驱动科学知识学习理解与科学观念建构，以应用层为载体探索应用过程实现知识向能力的转化，以创新层为目标指向高阶思维发展的科学实践与创新。科学教育分层进阶模式构建以《义务教育科学课程标准（2022年版）》为分层依据，整合课标规定的知识、技能与素养要求，促进科学课程核心素养培养与进阶层次有机融合，激发学生的思维发展水平从低阶向高阶跃升，夯实国家科技创新人才培养基础，助力教育、科技、人才高质量一体化发展，为提升全民科学素质和实现高水平科技自立自强提供有力支撑。

29 May 2026 | 16:00-16:45

Abstracts of Greater Bay Area Science Education Forum 2

大湾区科学教育论坛 2 [D1-LP-08]

报告1： 生成式人工智能背景下职前幼儿教师STEAM素养的培养路径与机制研究(226)

作者： 任丽婵

报告摘要： 职前幼儿教师的STEAM素养对于学前阶段STEAM教育的发展至关重要。然而，当前针对该群体STEAM素养培养的研究仍显不足，尤其缺乏可操作的“人工智能+STEAM”融合培养路径。为此，本研究以传统文化（特别是山西民俗文化）为切入点，依托《学前儿童健康教育》课程，以大学三年级学前教育专业48名学生为对象，开展为期18周（一学期）的教学实践。研究最终构建了由生成式人工智能赋能的“6P”教学模式，即问题锚定（Problem）、拆解分析（Parse）、方案设计（Plan）、分享互评（Pitch）、实战落地（Practice）与迭代优化（Polish）。同时，凝练出四维联动的培养机制：价值引领的动力激发机制、生成式AI全流程赋能支撑机制、基于PBL的贯穿式实践转化机制，以及三维联动的评价反馈机制。一学期的实践表明，学生STEAM素养（STEAM意识、STEAM知识、STEAM能力、STEAM价值观）与课程满意度均得到显著提升。本研究探索了生成式人工智能背景下幼儿教师STEAM素养的核心维度，提供了可复制、可推广的STEAM素养培养实践方案。针对当前研究周期较短、样本量有限的局限，未来计划扩大样本范围，并开展长期追踪研究，以进一步验证研究结论。

报告2： 职前科学教师对探究式教学“失控”的恐惧 ——基于比斯塔“教育之弱”的多案例研究 (115)

作者： 赵文清

报告摘要： 在探究式教学中，职前科学教师常将课堂中的不确定性感知为“失控”风险，并由此回到预设、控制与收束的教学方式。基于比斯塔“教育之弱”视角，本文采用多案例研究，对5名职前科学教师的课堂观察、反思文本与访谈资料进行主题分析，考察其“失控”恐惧的生成机制及其对教学实践的影响。研究发现，这种恐惧并非单纯的课堂管理焦虑，而是在绩效导向、程序化探究观与专业承受力不足的交互作用中生成。探究课堂中的“失控”问题因此并非单纯的教学技术问题，而是一个教育学问题。职前科学教师培养应重视教师面对不确定性时判断力、承受力与回应能力的发展。

报告3： 国家意志与公民教育：美国科学素养制度化的历史逻辑（1945-1995） (112)

作者： 付庭松

报告摘要： 科学素养诞生于二战结束之际的美国，其不仅是学术话语，更折射出国家对“合格公民”的期待。1945至1995年间，美国学术共同体持续通过“科学素养”转译国家在不同时代对公民角色的需求：从科学事业中“理解科学”的旁观者，到科技竞争中“认同科学”的动员对象，至科技风险中“评判科学”的决策主体，最终在全球经济博弈的驱动下走向“运用科学”的实践者，完成了公民从科学外围旁观到核心参与的制度化跨越。面向科技强国和社会主义现代化强国建设，中国科学教育改革需在政策驱动之外，强化学术共同体对本土化公民科学素养的理论建构。

报告4： 链接·赋能·生成：AI 驱动的馆校协同STEM 探究课程开发与素养培育 (112) (Online)

作者： 吴跃辉

报告摘要： 在教育数字化与“人工智能+教育”国家战略背景全面推进背景下，传统馆校协同普遍面临时空受限、资源僵化、教学模式单一、评价滞后等问题，难以支撑高质量STEM 科学探究实践。本文以广州黄埔长洲红色历史与军事科技场馆资源为实践载体，构建“AI 助教-学校教师-场馆讲解员”三师协同育人模式，以跨界链接打破场域、资源与主体三重壁垒，以智慧赋能重构探究教学、个性化学习与循证评价范式，以价值生成落实科学探究、工程技术、团队协作、创新思维与人文社会责任五大STEM 核心素养。研究形成可复制、可推广的“AI+馆校+STEM”课程开发路径，为智能时代中小学科学教育创新提供实践范式，推动校内外资源深度融合与育人模式转型。

29 May 2026 | 16:00-16:45

Abstracts of Greater Bay Area Science Education Forum 3

大湾区科学教育论坛 3 [D2-LP-10]

报告1： 基于STEAM教育理念的小学科技模型课程开发与应用研究 (98)

作者： 陈立志

报告摘要： 全球化与科技革新驱动教育范式转型，STEAM跨学科整合模式成为创新人才培养的关键路径。本研究在梳理STEAM教育概念认识与模型等理论基础上，提出小学科技模型STEAM课程的开发理念、原则、策略以及开发要素，构建“4主题12项目”课程框架，确立“三阶段四维度”培养目标和对应评价体系，通过“双师授课+分层实践”模式推进课程实施。实践表明，本课程能有效提升学生逻辑思维、团队协作与创新能力,为小学STEAM教育本土化实践提供理论参考与可复制的实践范例，对推动科学教育改革、培养复合型未来人才具有积极意义。

报告2： STEAM课堂话语如何驱动高阶思维发展？——基于滞后序列分析的实证研究 (107)

作者： 袁磊, 龙露露, 李丽均, 周乐莹

报告摘要： STEAM教育是培养高阶思维人才的重要路径，课堂话语则是推动学生高阶思维发展的关键支架。然而现有研究对STEAM课堂中师生话语如何驱动思维发展缺乏实证揭示。因此本研究以滞后序列分析为核心方法，基于跨越10个学期的75节实验课程，明确了课堂师生对话的结构特征，发现三类稳定对话序列模式，且不同教师提问类型对高阶思维的支架作用存在差异，学生高阶思维在话语中存在聚集涌现的现象但跨维度整合能力有待加强。对此本研究提出包含知识、问题、探究、反馈四个维度的高阶思维话语联动理论，丰富了跨学科课堂思维发展的理论体系与实践指导。

报告3： 从流程导向到能力发展：基于中国课标与加拿大安大略省课标中科学探究框架的比较 (109)

作者： 邱惠芬, 万志宏, 蓝海航

报告摘要： 通过比较中国义务教育化学课程标准与加拿大安大略省科学课程标准的科学探究框架，从框架结构、课程定位和证据类型三个维度展开分析。框架结构上，中国的七环节框架强调方法论的系统性与完整性，安大略省的四阶段框架配套四级能力进阶标准（意识、萌发、精熟、拓展），侧重能力发展的连续性与层次性。课程定位上，中国将探究融入学科核心素养并依托五大主题实施，有利于探究与学科知识的深度融合；安大略省将探究设为占总课时30%–40%的独立板块（Strand A），便于跨学科迁移。证据类型上，中国设置了10个跨学科实践活动，实际教学中以实验数据为主要来源；安大略省明确列举实验、观察和技术三类数据来源，强调多元证据的整合运用。两种框架各具特色，也各有可优化之处。基于比较与互鉴，提出两点启示：一是在保持方法论系统性优势的基础上建立分层次的能力描述标准，从流程导向向能力发展导向拓展；二是在巩固实验技能培养的同时深化跨学科实践活动，从以实验为主向多元证据整合拓展。

报告4： 面向拔尖创新人才早期培养的STEM课程研究——基于泰勒原理的视角 (215) (Online)

作者： 马乃珍

报告摘要： 在我国持续推进教育强国建设的大背景下，拔尖创新人才的早期识别与系统培养被当作新时代基础教育改革的关键方向。STEM教育具备跨学科融合，项目式学习还有综合素养能力培育等许多优势，正日益广泛地变成培育拔尖创新人才的有效方法。但是国家当下STEM课程的实际情况还存在不少短板，在目标的设定，内容的安排，学习经验的设计还有评价反馈等方面都还需要进行体系化的整合。本研究以泰勒课程原理当作理论视角，从课程目标，学习经验，课程组织还有评价机制这四个维度，对国内外STEM教育课程的发展历程，构建逻辑以及实践经验开展系统地梳理，解析它在拔尖创新人才早期培养方面的适用性以及实际问题。在此基础之上，本研究提出构建目标导向，经验驱动，系统整合，闭环评价一体化这样的课程体系建议，并对未来STEM课程发展的趋向进行展望，旨在为新时代基础教育当中拔尖人才的系统培养提供理论方面的支撑以及课程实施方面的参考。

30 May 2026 | 10:00-11:00

Abstracts of Greater Bay Area Science Education Forum 4

大湾区科学教育论坛 4 暨科学素养提升联盟会议 [D2-LP-03]

报告1： 以社会性科学议题学习驱动区域科技教育的“环翠方案” (120) (Online)
作者： 王静
报告摘要： 山东省威海市环翠区经过六年实践，以社会性科学议题学习（SSI-L）为核心，形成科技教育推进的“环翠方案”。该方案立足SSI-L的三重价值：以真实议题驱动学习、以跨学科融合培育完整的人、以证据论证发展核心素养。针对区域落地难题，系统突破三大关键点：组建多学科导师团与分层教研体系破解教师瓶颈；依托校际联盟与资源共享平台保障资源普惠；推动成果向社会转化并引入多元评价赢得广泛认同。实践表明，该方案有效促进学生从知识接受者向问题解决者转变，推动教师专业成长与教研生态重构，带动区域教育生态的整体变革，为落实国家科技教育战略提供了可操作、可推广的区域实践范式。

报告2： 基于社会性科学议题的跨学科实践活动设计——以“‘七日减肥食谱’真的健康吗？”为例 (202) (Online)
作者： 龚颖, 曹颖, 张崇华, 丁满花
报告摘要： “健康生活”作为核心素养的重要维度，要求其应科学认识自我、合理规划人生。本研究围绕“饮食与健康”这一社会性科学议题，以“‘七日减肥食谱’真的健康吗？”为例，依托SIMBL模型，融合化学、生物、数学与体育等学科视角，通过食谱探秘、膳食探究、辩论研讨等教学活动，引导学生从食谱科学性、减肥药合理性、如何健康生活这三大核心问题展开跨学科实践。在此议题情境下，学生经历“甄别—检验—验证—重构”的完整过程，不仅发展了学科思维、科学观念和社会责任，也完成知识学习到素养提升的转变，为落实科学素养的发展提供适切的路径。

报告3： 在海洋教育中的实践探索与启示——以威海“海滨城市海洋牧场推广”项目为例 (206) (Online)
作者： 崔文浩
报告摘要： 社会性科学议题（SSI）教学作为核心素养导向的重要路径，强调真实情境、跨学科整合与伦理思辨。本文以威海市开展的“海滨城市是否应大力推广海洋牧场”SSI教学项目为案例，系统梳理其顶层设计、活动实施、评价机制与育人成效。
项目通过“原理建模—生态评估—成本核算—政策建议”四阶递进式学习路径，引导学生综合运用生物学、经济学、地理与政策分析等多学科知识，开展实证调研与科学论证，最终形成提交给政府的可行性建议书。SSI教学有效提升了学生的批判性思维、社会责任感与科学决策能力，为区域推进科学教育改革提供了可复制、可推广的范例。

30 May 2026 | 11:30-12:15

Abstracts of Greater Bay Area Science Education Forum 5

大湾区科学教育论坛 5 [D1-LP-08]

报告1： 多智能体赋能小学STEM教育研究：协同机制、关键模式及实施保障 (217)

作者： 卢怀裕, 张誉月, 吴强

报告摘要： STEM 教育在我国教育体系中快速发展，但协作支持不足制约了其深入实施。基于问题构建了涵盖认知逻辑、规范逻辑与物质实践逻辑的多智能体协作框架，并据此形成协作应用模式和支持保障机制，可有效促进小学 STEM 教学的跨学科整合与创新能力培养。

报告2： 十万个为什么：基于红树林保护区的校外科学探究实践课程开发与实施 (213)

作者： 吴黛

报告摘要： 随着核心素养导向的教育改革深化，校外实践课程成为连接学科知识与真实世界的重要桥梁。本研究基于核心素养教育理念，以广东内伶仃福田国家级自然保护区为实践场域，开发了“探索红树林保护区的‘十万个为什么’”跨学科课程。通过构建以“问题循环”为核心、四大要素为支撑、“三阶段·六环节”为实施路径的课程模型，实现了校外实践课程的系统化设计。课程以学生自主生成的问题为驱动，融合多学科知识与智能技术支持，引导学生在真实情境中完成从问题提出到成果发布的完整探究过程。两年多的实践表明，该课程显著促进了学生提问能力、批判性思维及生态素养的提升，形成了可推广的校外课程实施范式，为基础教育阶段跨学科实践课程的开发提供了重要参考。

报告3： 资源配置视角下粤港澳湾区小学科学教育的公平与包容路径 (220)

作者： 张杰志

报告摘要： 粤港澳大湾区作为我国科技创新核心集聚区和教育融合发展前沿阵地，小学科学教育的公平与包容是培育青少年科学素养、夯实科技创新人才根基的关键。当前，湾区小学科学教育在政策引导下取得显著进展，但资源配置不均衡问题突出，成为制约教育公平与包容的核心瓶颈，具体表现为区域间、城乡间资源投入差距显著，三地资源整合不足，特殊群体资源供给缺失。本文以资源配置均衡化为核心，结合2022-2024年湾区小学科学教育相关数据，通过表格分析、案例论证等方式，剖析资源配置失衡的具体表现及深层原因，借鉴国内外典型实践经验，提出针对性优化路径，推动湾区小学科学教育资源均衡配置，实现公平与包容发展，为湾区教育融合与科技创新发展提供支撑。

报告4： 智能时代基于深度学习的单元教学设计与实践 (218)

作者： 吕小珍, 汤祖军

报告摘要： 智能时代背景下，深度学习是培养学生核心素养与创新能力的重要路径[1]。本文以初中信息科技科技八年级第二单元《家中的精灵_探秘智能家居环境监测系统》为研究载体，遵循“目标导向-情境建构-活动设计-评价反馈”的深度学习课堂设计逻辑，构建“三阶九步”单元教学框架，涵盖“认知激活-探究实践-迁移创新”三个阶段，整合信息技术、物理学、工程学等跨学科知识，通过真实问题情境创设、项目式学习活动设计、多元评价体系构建，引导学生实现从“知识掌握”到“能力形成”再到“素养落地”的进阶。同时，结合教学实践案例，详细阐述各环节的实施策略与效果分析，为智能时代跨学科主题下的深度学习教学设计提供参考范式。。

30 May 2026 | 11:30-12:15

Abstracts of Greater Bay Area Science Education Forum 6

大湾区科学教育论坛 6 暨科学素养提升联盟会议 [D2-LP-03]

报告1： 市井烟火中的SSI校本课程探索与实践 (207) (Online)
作者： 李蕾, 刘才胜
报告摘要： 新课标核心素养导向下，义务教育课程强调跨学科实践与真实问题解决，社会性科学议题（SSI）是培养学生科学思维、伦理判断和公民参与素养的重要载体，其落地需贴近师生生活。威海市塔山中学以塔山早市为SSI主题切入点，以“感知—分析—决策”三层驱动性问题引领，构建多维框架，整合十三门学科知识，通过五大主题探究开展实践。课程直面教师角色转型、评价方式单一等挑战并探索解决策略，驱动学生实现身份转变，破解学科壁垒，让核心素养落地，为SSI校本课程开发实施提供了可操作的实践路径。

报告2： 基于现实议题的跨学科教学设计与实践——以“鱼菜共生”为例 (208) (Online)
作者： 王子洁, 吴彦军, 张黛静
报告摘要： 针对当前跨学科教学存在的“学科叠加”“缺乏真实情境”“重操作轻思维”等“假跨”“硬跨”的实践困境，本研究以当前社会中的现实议题为驱动，为跨学科教学的高质量实施提供高参考价值的设计策略与实施建议。本研究构建跨学科教学设计策略框架，并通过实践案例加以说明策略构建的理念与思路。案例依托“耕地与水资源短缺及农业污染治理”议题，以“鱼菜共生系统搭建与监测”为实践项目，面向初三学生开展现实议题驱动的跨学科教学实践。结果表明，该教学模式能有效实现学科间的深度融合；学生的跨学科知识整合能力、批判性思维、科学素养显著提升，同时锻炼了多视角推理与决策能力，深化了可持续发展理念与环境保护的社会责任意识。

报告3： 社会性科学议题视域下中学“低碳校园”跨学科课程的设计与实施 (210) (Online)
作者： 王成, 罗铣吉, 孙翊斐, 李梦豪
报告摘要： 本研究以“低碳校园”为核心社会性科学议题，设计并实施了一项面向中学生的跨学科课程。课程整合科学、技术与社会视角，通过“碳排放核算-利益相关者分析-减碳方案设计”的递进式探究路径，引导学生从量化分析、伦理权衡及系统优化等多维度，深度参与校园低碳转型的真实问题解决。研究采用基于设计的实证方法，在中学课堂中系统应用“问题链”驱动、多样化“脚手架”支持及AI辅助评价等教学策略。实践表明，该课程有效促进了学生社会性科学推理、跨学科问题解决及可持续发展素养的协同发展，为在中学阶段依托真实、复杂的SSI开展科技伦理与责任教育提供了可操作的教学范式和实证案例。

报告4： 数智时代科学家精神的具身化传承：三元对话机制在化学科普实践中的社会教育功能研究 (212) (Online)
作者： 李佳
报告摘要： 数智时代，如何将抽象的科学家精神转化为具身化的社会教育实践是STEM教师教育的核心课题。本研究依托“大学-教研中心-科技馆-中学”（URMS）协同育人共同体，系统探讨“师-机-生”三元对话机制在化学科普实践中的社会教育功能。研究以职前化学教师为对象，引导其利用DeepSeek、豆包等AI智能体，围绕“曾侯乙编钟”、“越王勾践剑”等本土科技资源，与学科专家、AI助手及青少年开展多轮深度对话，人机共创跨学科科普方案。实证分析表明，AI作为“认知伙伴”有效破解了科学精神传播中理论与实践割裂的痛点。职前教师在人机协同中实现了从“知识传授者”向“学习设计师”的身份转型。研究证明，该机制通过馆校联动不仅增强了科普的临场感，更实现了科学家精神在“教师教育者-师范生-青少年”间的代际传递，为非正式环境下的科学教育提供了可推广的中国范式。

30 May 2026 | 13:30-14:30

Abstracts of Greater Bay Area Science Education Forum 7

大湾区科学教育论坛 7 [D1-LP-08]

主旨报告1：指向探究实践核心素养育人的科技教育课程建设思考与行动
报告人：罗星凯 广西师范大学
报告摘要：加强中小学科学与技术教育（简称“科技教育”），已成为教育强国战略重要内容。而如何通过日常的课程与教学落实探究实践核心素养育人目标，则是需要持续研究和创新实践逐步化解的难题。科技教育改革催生的兴华科技教育团队（简称“兴华团队”），为开拓科学（7~9年级）新课程专业支持和科技教育新学科新专业建设工作，选择直面科技课程综合化升级、实践性落实和项目化实施诸多难题，用几十年沉底一线聚焦“课程、师资和评价”两难的持续攻坚，开创和推广“中国版融合式STEM课程《探究科技》、“兴华创新实践师资班”项目和“青少年科技运动会”活动的扎实成果，不仅有效助力科学教育新学科新专业建设脱困，而且先后通过创立“兴华科教”、承办“兴华平台”，让“兴华团队”获得“双轮”支撑和“双核”驱动，为新时代加强中小学科技教育工作的可持续发展，构建起难得创新保障生态。

主旨报告2：从《光的直线传播》实验，解析数字化实验对学生科学模型构造能力的提升
报告人：李鼎 上海市中小学数字化实验系统研发中心
报告摘要：光的直线传播这个科学概念，看似简单，但讲起来并不容易。针对小学生和初中生的认知特征，报告人基于数字化实验、数字孪生技术和增强现实手段开发了相关创新实验设备，以科学模型和猜想、验证为主要认知促进手段，不仅圆满解决了光的直线传播教学难题，还解决“影子成因”等物理问题和“等比例关系”等几何数学问题。

30 May 2026 | 14:30-15:30

Abstracts of Greater Bay Area Science Education Forum 8

大湾区科学教育论坛 8 [D1-LP-08]

报告1：敏捷治理视域下 UGS 科学教育模式探索——以“海岛项目”科学探究课程为个案

报告人：叶碧欣、曾飞鹏 珠海文园中学副校长

报告摘要：面对新时代科学教育从知识验证向素养生成转型的需求，以及海岛科学教育资源配置面临的时空阻隔难题，本研究基于敏捷治理视角，构建了“高校赋能-政府统筹-学校主体”的UGS 协同创新模式。在该模式中，政府作为资源调度中枢，打破部门壁垒，实现交通、食宿与人才资源的快速调配；高校作为智力核心，通过课程共建与技术下沉，提供专业引领；学校作为实践基地，通过项目式学习推动素养落地。研究依托万山群岛独特自然与人文资源，开发了“生态探秘、地质解码、文化传承”科学探究项目课程，借助AI赋能实现了从问题引发、探究实践、成果转化到反思交流的敏捷课程实施。实践表明，该模式有效促进了陆岛资源的深度融合与动态匹配，为破解区域科学教育资源不均衡问题提供了实践参考。

报告2：科技赋能非遗传承：初中英歌舞校本课程数字化资源库的构建与教学实践研究

报告人：潘颖懿 东莞中学

报告摘要：针对初中英歌舞教学中师资力量薄弱、资源标准缺失、传承可持续性不足等现实问题，本研究以建构主义学习理论和数字化教育资源设计理论为指导，构建“理论库-动作库-音乐库-文化库”四位一体的英歌舞数字化资源库，并通过一学期的行动研究验证其应用效果。结果显示，该资源库大幅提升教学效率、学生学习主动性及传承规范性，为非遗校园传承提供可复制的“新基建”方案。同时，研究指出资源库建设中的版权规范、技术门槛与团队协作挑战，并提出平台化、互动化、联盟化的未来发展方向。

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