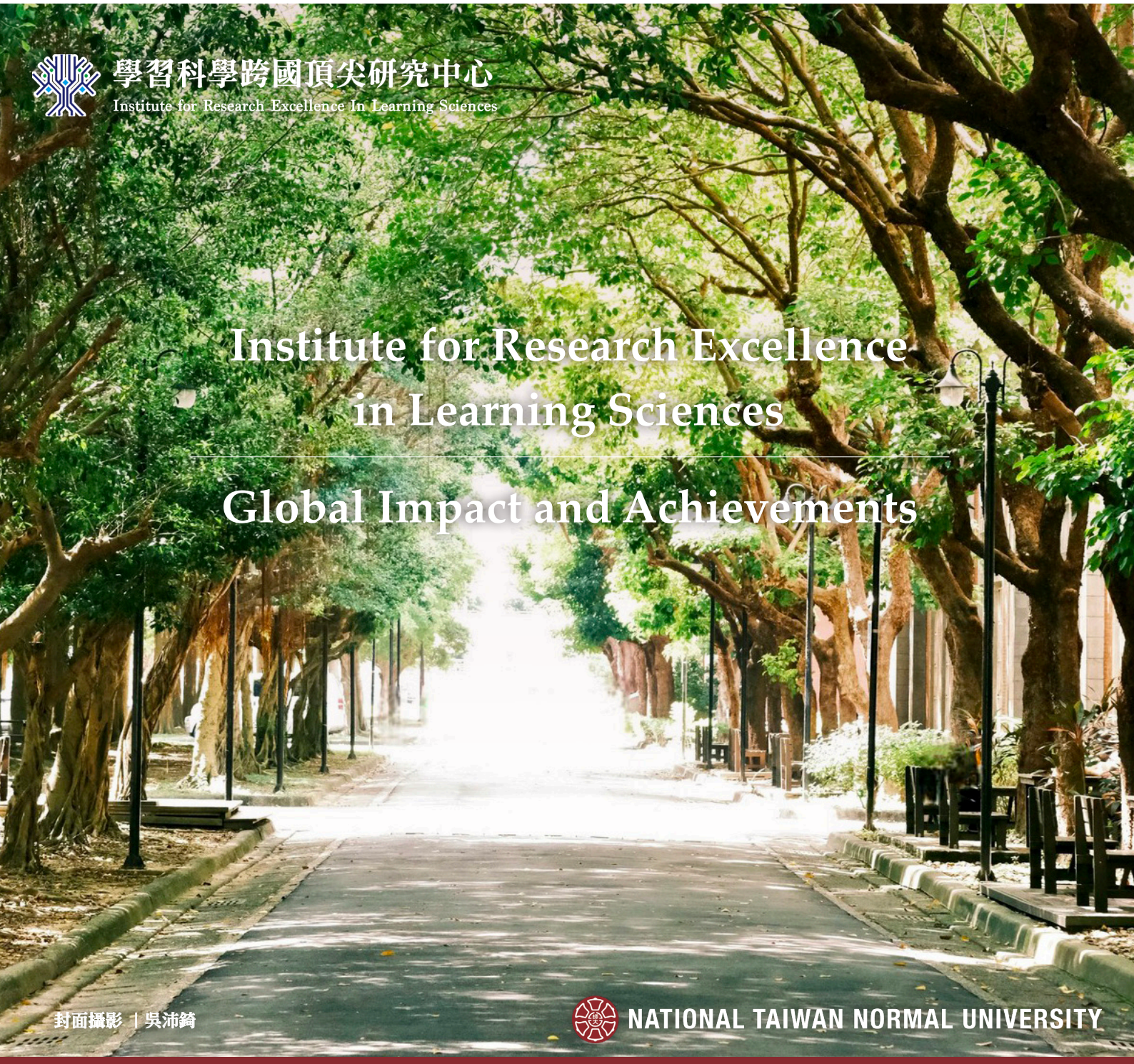
NATIONAL TAIWAN NORMAL UNIVERSITY

Featured Research Newsletter

ISSUE 09 | AUTUMN 2025



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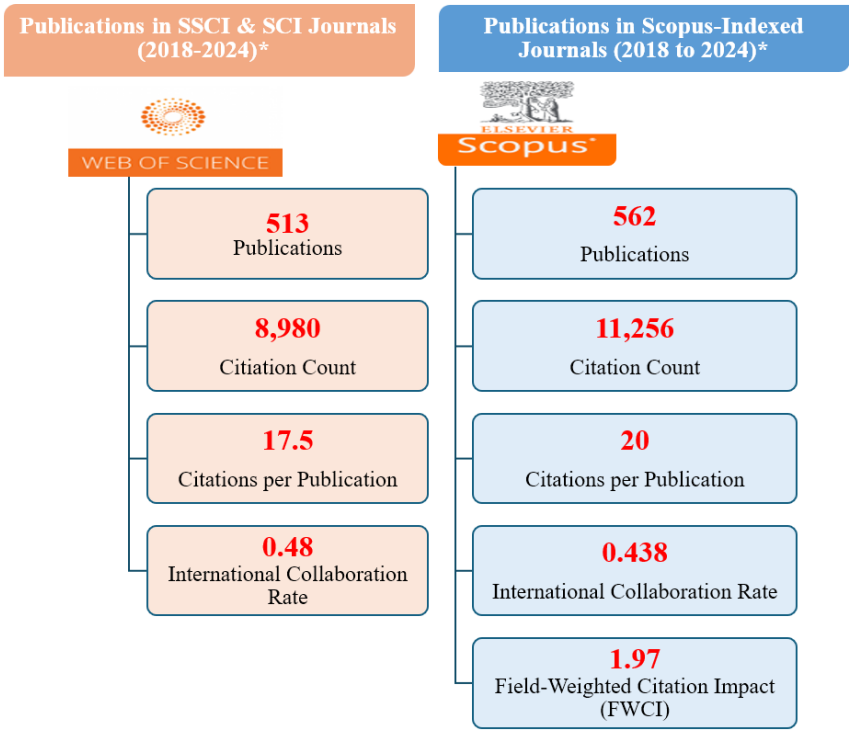
IRELS Introduction

Institute for Research Excellence in Learning Sciences(IREL): Global Impact and Achievements

Established in 2013 at NTNU, the Institute for Research Excellence in Learning Sciences (IRELS) unites expertise across psychology, education, and technology to tackle pressing educational challenges in Taiwan and worldwide. Guided by its principles of Openness, Sharing, Collective Knowledge, and Sustainability (OSaCKS), IRELS has become a hub for innovative research in STEM education, digital learning, big data, and educational neuroscience.

With four major research tracks—STEM Education, Precision Digital Learning, Educational Measurement & Big Data, and Educational Neuroscience—IRELS contributes nationally and internationally to advancing the learning sciences, training future educators, and shaping the future of education.

Academic Performance



*(*based on search conducted on August 4, 2025)*

World's Top 2% Scientists

On September 19, 2025, eleven researchers from IRELS were named to the *Career-Long Scientific Impact (1960–2024)* list, while eleven researchers were recognized on the *Single-Year Scientific Impact (2024)* list of the *World's Top 2% Scientists*.

Notably, several scholars were honored in both categories, underscoring NTNU's sustained excellence and far-reaching impact in global research. Related Links: World's Top 2% Scientists 2024.

List of Career-Long Impact (1960-2024)	List of Single Year Impact (2024)
• Prof. Tsai Chin-Chung	• Prof. Tsai Chin-Chung
• Prof. Chang Chun-Yen	• Prof. Chang Chun-Yen
• Prof. Sung Yao-Ting	• Prof. Sung Yao-Ting
• Prof. Wu Hsin-Kai	• Prof. Chang Yu-Kai
• Prof. Chang Yu-Kai	• Prof. Chen Nian-Shing
• Prof. Chen Nian-Shing	• Prof. Liang Jyh-Chong
• Prof. Tsai Meng-Jung	• Prof. Hong, Jon Chao
• Prof. Hong Jon Chao	• Prof. Wu Hsin-Kai
• Prof. Liu Tzu-Chien	• Prof. Tsai Meng-Jung
• Prof. Tseng Yuen-Hsien	• Prof. Chang Hsin-Yi
• Prof. Liang Jyh-Chong	• Prof. Lin Tzung-Jin

Cover Story

Prof. Jon-Chao Hong: Shaping the Future of AI and Education

At National Taiwan Normal University (NTNU), Prof. Jon-Chao Hong is redefining how technology transforms learning. A trailblazer in digital innovation, he has spent decades weaving together game-based learning, STEAM creativity, and the learning sciences to inspire students and empower educators. As Director of the Digital Game-Based Learning Laboratory and a key member of the Institute for Research Excellence in Learning Sciences (IRELS), Prof. Hong has built more than 20 educational apps and 10 immersive VR systems—spanning disaster preparedness, cultural heritage, and performing arts—setting global benchmarks in educational technology.

In just the past three years, he has published over 60 journal articles while spearheading international platforms such as the International Exhibition for Young Inventors (IEYI), the iSTEAM-PowerTech Contest, and the GoSTEAM Contest. His leadership bridges research and practice, showing students how science and creativity can come alive through invention and collaboration.

Empowering Young Innovators with AI

This summer, Prof. Hong and IRELS partnered with the New Taipei City Education Bureau to launch two groundbreaking AI-powered learning programs:

- AI Tools for Invention Camp

Over 130 students explored how AI can spark innovation in fields like disaster prevention, healthcare, and green energy. Using the SCAMPER method alongside AI tools such as ChatGPT and MidJourney, students refined their ideas, conducted patent searches, and built visual prototypes—turning imagination into invention.

- AI Exploration Camp

Engaging more than 240 students across 10 schools, this program integrated AI into science, arts, and social studies. From poetry writing to empathy-building workshops, students discovered how AI can expand creativity, sharpen critical thinking, and strengthen collaboration.

Together, these programs highlight NTNU's vision for future-ready learners: students who not only master technology but also approach challenges with empathy, resilience, and imagination.

Inspiring the Next Generation

From international competitions to local classrooms, Prof. Hong's work continues to connect communities and cultivate a culture of innovation. Under his leadership, NTNU is shaping a new era of education—where AI and creativity go hand in hand, and where students are prepared to lead with responsibility, curiosity, and heart.

Fig. 1. Participants of the AI Tools for Invention Camp, together with Prof. Chi-Ruei Tsai of National Taiwan Normal University and students from Sanchong Commercial and Industrial Vocational High School.

Figure 2: COOL Chinese DigFig. 2. Participants of the AI Exploration Camp with Prof. Jon-Chao Hong (洪榮昭教授), Zhang Ming-Wen (張明文局長), Director of the New Taipei City Education Bureau; Chien-Ming Wen (翁健銘科長), Section Chief; Li-Hsing Chen (陳力行), Acting CFO of Chih Shang Electronics Co., Ltd.; and Hsiu-Chu Tseng (曾秀珠校長), Principal of Xiulang Elementary School.ital Learning Platform Interface.

Additional News and Highlights

Research News

Epigenetic Regulation of Neuronal Pathways as Biomarkers to Explore Cognitive Function in Adolescents

A research team at National Taiwan Normal University (NTNU) is uncovering how subtle molecular signals in the blood may explain differences in how adolescents learn, remember, and reason. Their latest findings point to epigenetic biomarkers—particularly non-coding microRNAs (miRNAs)—as potential predictors of student cognitive function and academic performance.

Tracing the Biology of Learning

For years, researchers have studied how genetic variants and neurotransmitter pathways influence brain plasticity, the foundation of memory and learning (Lee et al., 2019, 2021). By examining correlations between protein expression and the brain's mechanisms of long-term potentiation (LTP) and long-term depression (LTD), the team has mapped how gene activity regulates cognition and emotion within the cerebrum.

Recent work highlights the CaMKIIα/SIRT1/BDNF system as a key pathway:

- Higher CaMKIIα levels in blood plasma are linked to better academic and cognitive performance.
- Higher SIRT1 levels correlate with lower scores, with differences observed between male and female students.

These findings align with student outcomes on major learning assessments such as the Comprehensive Assessment Program (CAP), the SCIA scientific reasoning test, and iSTAR (Lee et al., 2025).

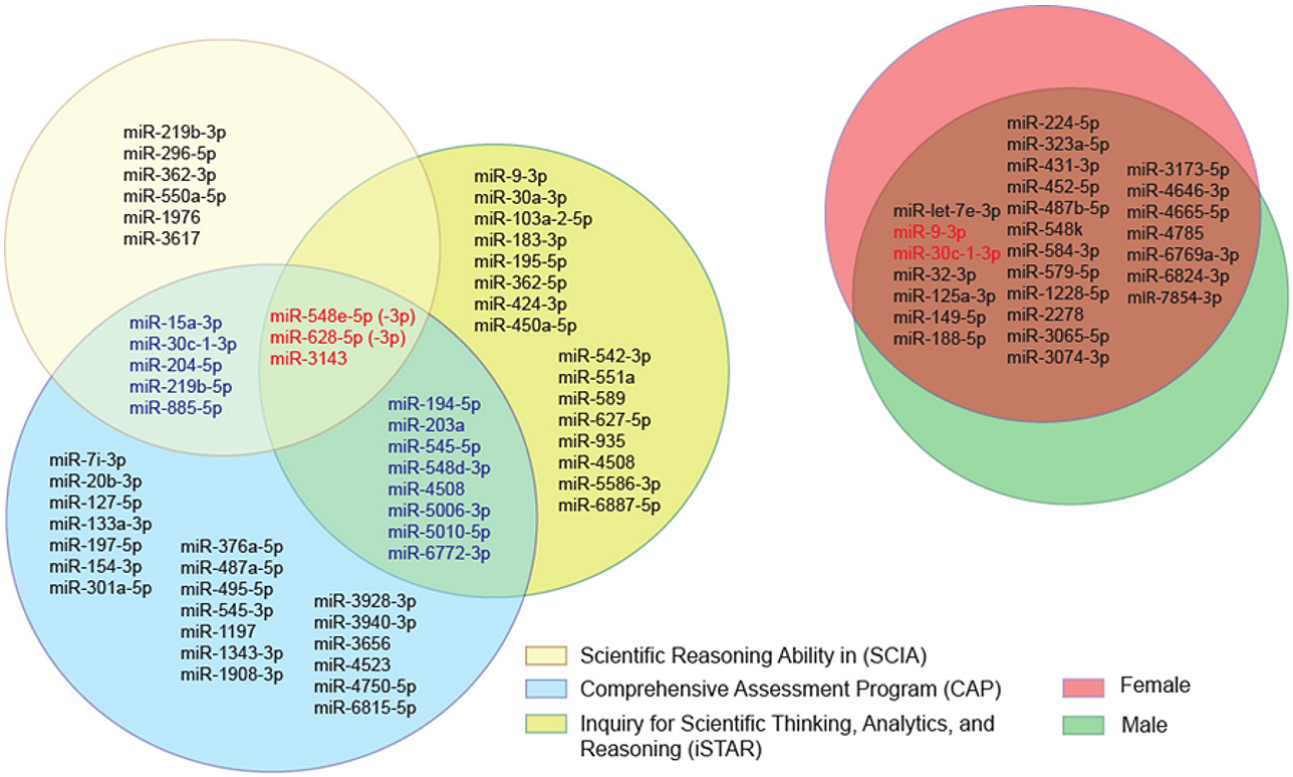


Fig.3. Differentially expressed miRNAs across three assessments. When students are grouped by higher and lower scores, the results reveal both shared and distinct non-coding microRNA (miRNA) patterns involved in gene expression and regulation.

The Role of microRNAs

The most novel insight comes from the role of miRNAs—small non-coding molecules that regulate gene expression. Dr. Lee's team has proposed a new hypothesis: that specific miRNAs can predict the balance of LTP and LTD, the processes by which neural connections are strengthened or weakened.

In particular, the miR-30a/30c-1/195/204 cluster appears to modulate the CaMKIIα/SIRT1 signaling pathway, linking cellular regulation to measurable cognitive performance.

Taken together, the findings suggest that miRNAs may serve as non-invasive biomarkers of adolescent cognition, offering new tools for understanding and supporting learning.

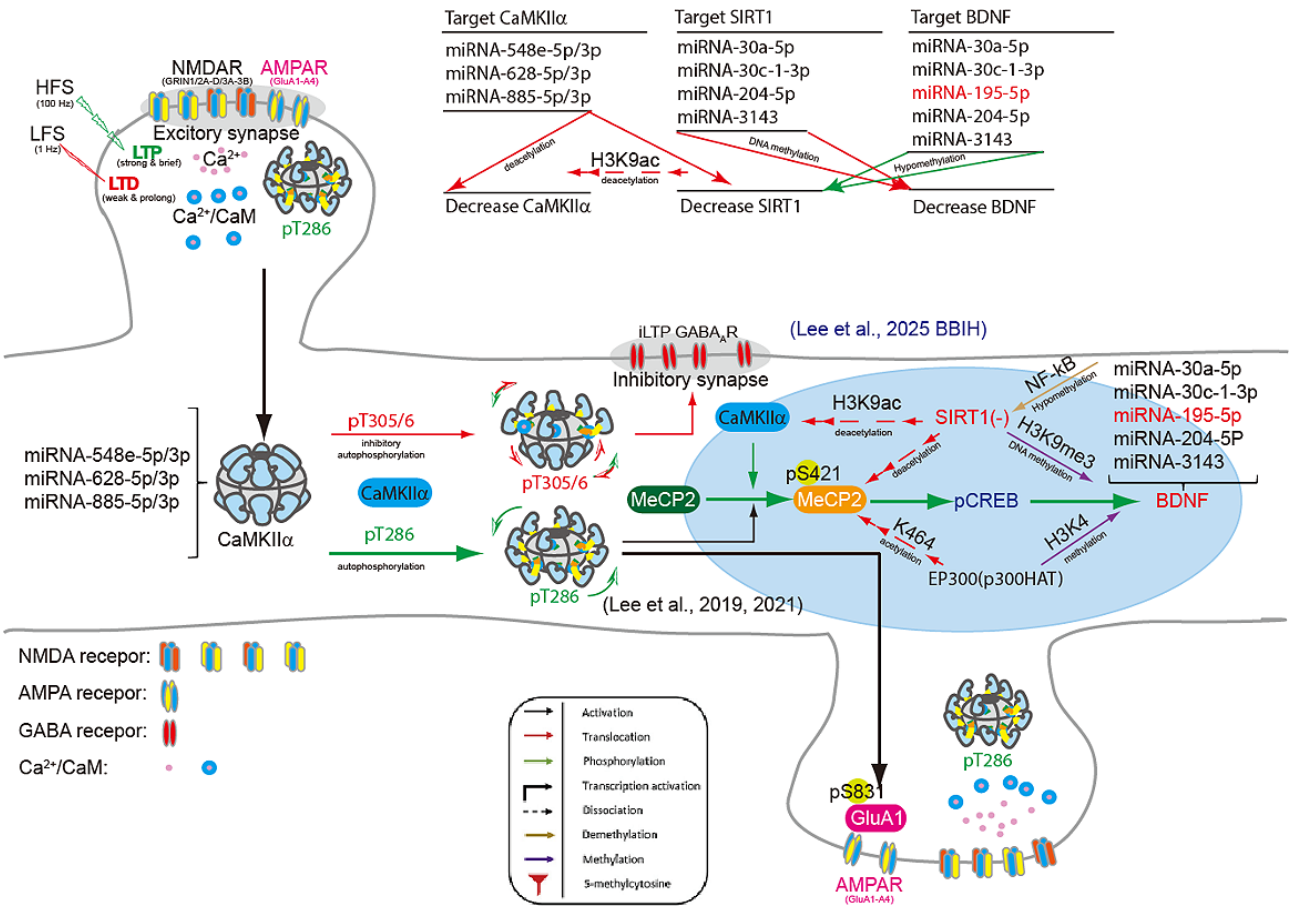


Fig. 4. Epigenetic regulatory platform of plasma microRNAs (miRNAs). Plasma miRNAs act as regulatory factors that can predict the balance between long-term potentiation (LTP) and long-term depression (LTD), the core processes of synaptic plasticity underlying learning and memory.

Researcher Behind the Discovery

This study is led by Dr. Li-Ching Lee, who earned her Ph.D. from NTNU in 2009. Her earlier research established CaMKIIα as a critical gateway for epigenetic memory (Lee et al., 2019, 2021). Building on this foundation, Dr. Lee now focuses on using epigenetic biomarkers to evaluate student performance and examine the impact of long-term stress on reasoning and scientific inquiry skills.

Rather than viewing molecular biology as separate from education, Dr. Lee emphasizes the importance of linking laboratory findings with classroom outcomes. Her team's vision is to use biological markers not only to understand how students learn but also to develop more effective strategies to support academic growth and resilience.

Through this pioneering work, Dr. Lee and her colleagues position NTNU at the forefront of global research connecting neuroscience, epigenetics, and education—revealing how biology shapes learning in the classroom of tomorrow.

Reference:

Li-Ching Lee, Ming-Tsan Su, Lei Bao, Po-Lei Lee, Shane Tutwiler, Ting-Kuang Yeh & Chun-Yen Chang*. MicroRNAs modulate CaMKIIα/SIRT1 signaling pathway as a biomarker of cognitive ability in adolescents. Brain, Behavior, & Immunity - Health, 44(2025) 100970.*

Li-Ching Lee, Ming-Tsan Su, Hsing-Ying Huang, Ying-Chun Chao, Ting-Kuang Yeh and Chun-Yen Chang*. Association of CaMK2A and MeCP2 signaling pathways with cognitive ability in adolescents. Molecular Brain, (2021) 14:152 page 1-14.*

Li-Ching Lee, Ming-Tsan Su, Ying-Chun Cho, Guey-Jen Lee-Chen, Ting-Kuang Yeh and Chun-Yen Chang*. Multiple epigenetic biomarkers for evaluation of students' academic performance. Genes, Brain and Behavior, (2019) 18 e12559.*

Research News

Unique Brain Connectivity in Gelotophobes on the Fear of Laughter

Laughter is often regarded as a universal signal of joy. Yet for some individuals, hearing others laugh can trigger deep discomfort and fear. This condition, known as gelotophobia, describes those who are oversensitive to laughter and interpret it as ridicule or shame.

Dr. Hsueh-Chih Chen, professor of cognitive psychology at NTNU, and his research team investigated the neural mechanisms behind gelotophobia. Using resting-state functional magnetic resonance imaging (rs-fMRI), they examined how brain networks differ between gelotophobes and non-gelotophobes, offering new insights into the condition.

Study Overview

- Participants: 183 neurologically healthy individuals, including 64 identified as gelotophobes.
- Method: rs-fMRI analysis of three key networks — the limbic system, the default mode network, and the executive control network.
- Focus: Neural connectivity patterns related to emotion regulation, self-referential thinking, and cognitive control.

Key Findings

- Heightened sensitivity: Gelotophobes exhibited stronger amygdala–striatum connectivity, suggesting amplified fear responses and vigilance toward social cues.
- Self-focused processing: Enhanced connectivity between the posterior cingulate cortex and temporoparietal junction indicated stronger tendencies to interpret laughter in self-referential ways.
- Hyper-attention to social signals: Greater connectivity in the superior frontal gyrus–supplementary motor area was linked to anxiety-driven monitoring of social environments.
- Adaptive regulation in non-gelotophobes: By contrast, non-gelotophobes showed stronger amygdala–motor cortex connectivity, supporting more flexible emotional and behavioral responses.

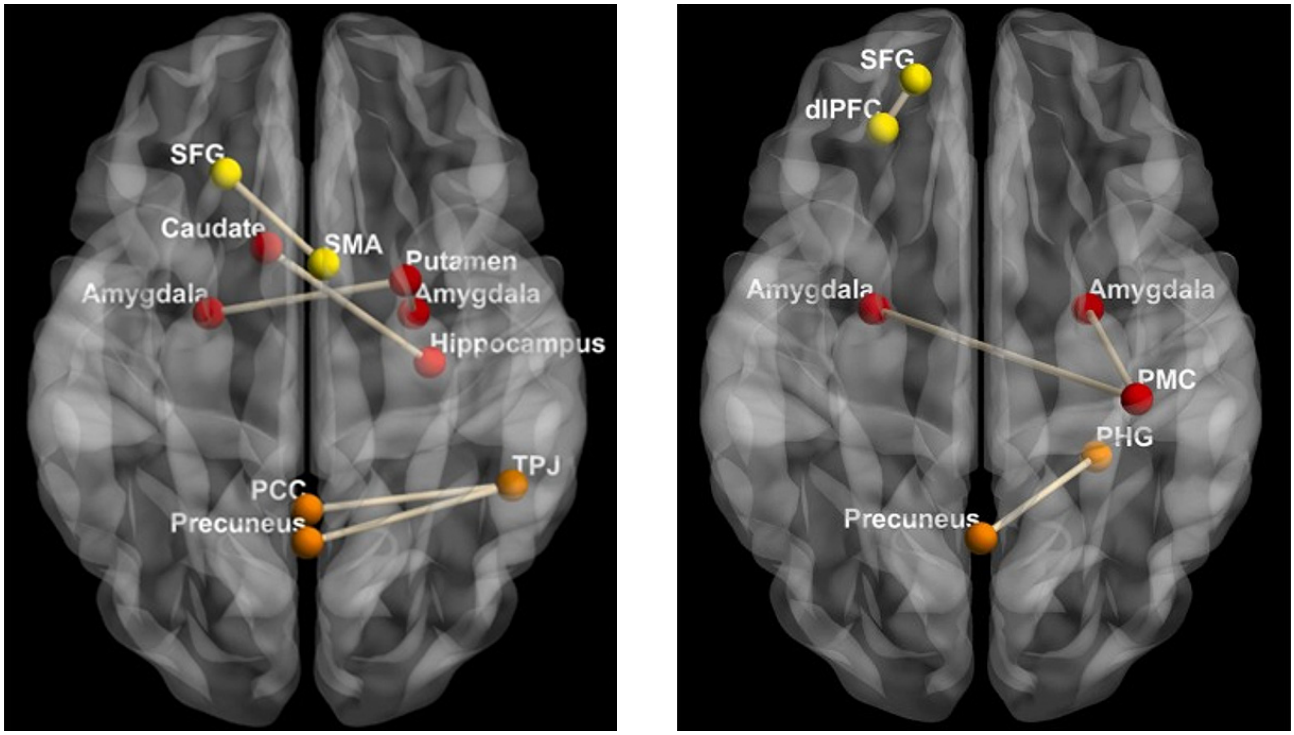


Fig. 5. Resting-state functional connectivity maps of gelotophobes (left) and non-gelotophobes (right).

Significance

The study suggests that gelotophobes remain in a heightened neural readiness even at rest, with stronger emotional responses and self-referential interpretations of laughter. This shifts the understanding of gelotophobia from being merely a personality trait to a condition with measurable neurobiological underpinnings.

Such insights not only deepen knowledge of humor psychology but also offer potential directions for interventions addressing social anxiety and fear of negative judgment.

▶ *Full paper: Behavioral Brain Research, 2024*

Research News

It's not about sense of humor, but your emotional state!

Humor is more than just a matter of jokes — it also depends on how we feel when we hear them. Dr. Hsueh-Chih Chen and his research team at NTNU explored how emotional state influences humor appreciation, offering new perspectives on the psychology of laughter.

Study Overview

- Participants: 96 individuals divided into positive, neutral, and negative emotion groups.
- Method: Mood induction via autobiographical recall (happy, neutral, or sad events).
- Task: Participants rated comprehension, amusement, and surprise after reading five incongruity-resolution jokes and five nonsense jokes.

Key Findings

- Mood shapes amusement: Emotional state significantly influenced amusement ratings, though not comprehension or surprise.
- Positive emotion enhances humor: Participants in a positive mood rated jokes as more amusing than those in a negative mood.
- Nonsense jokes require playfulness: In negative states, participants found nonsense jokes less funny, likely due to reduced openness and narrowed affective bandwidth.
- Incongruity-resolution jokes are robust: Both positive and negative mood groups found incongruity-resolution jokes amusing, suggesting this type of humor withstands emotional fluctuations.

Significance

The study highlights that emotional state plays a crucial role in humor appreciation, particularly for nonsense humor. These findings have practical applications in clinical and educational settings:

- Therapy and counseling: In low-mood contexts, incongruity-resolution jokes may be more effective than nonsense humor.
- Daily communication and teaching: Tailoring humor to the audience's mood can enhance engagement and rapport.

Future Directions

The research team plans to expand their work by including a wider range of joke types and employing stronger mood induction techniques (e.g., music, images, videos) to further explore the dynamic interaction between mood and humor.

▶ *Full paper: International Journal of Psychology, 2024*

Engagement News

NTNU and New Taipei City Launch AISI: Pioneering AI Self-Learning for Smart Education

On April 9, 2025, National Taiwan Normal University (NTNU), in collaboration with the New Taipei City Government's Education Department, officially launched AISI (https://aisi.tw), a next-generation AI self-learning platform designed to transform classroom practices and student learning.

Empowering Schools and Classrooms

Through this collaboration, AISI is being piloted in New Taipei schools, providing personalized learning support for students from elementary to high school. Teachers can integrate AISI into their lesson design, access curated resources, and adapt content to student needs. This dual support system enriches classroom dynamics while making learning more interactive and student-centered.

Positive Feedback from the Pilot

Early responses have been highly encouraging:

- Teachers reported improved efficiency in lesson preparation and stronger student engagement.
- Students described AISI as a "smart learning partner" that offers step-by-step guidance through complex problems.

Building on New Taipei's existing Four Learning Modes—self-learning, peer learning, inter-group learning, and teacher-guided learning—this initiative introduces a fifth dimension: AI-assisted learning. The integration of AISI marks a milestone in NTNU–New Taipei cooperation and sets a new benchmark for the future of smart education in Taiwan.

Fig. 6. Group photo of NTNU and New Taipei City representatives at the AISI launch event on April 9, 2025.

Engagement News

NTNU × Xinsheng Elementary School Launch "AI Robot Teacher × Bilingual STEAM Summer Camp"

To promote AI education and strengthen interdisciplinary learning, Professors Hsien-Sheng Hsiao and Nian-Shing Chen from NTNU's Institute for Research Excellence in Learning Sciences (IRELS) partnered with Xinsheng Elementary School in Daan District, Taipei, to host the *2025 Summer Camp: AI Robot Teacher × Bilingual STEAM Camp*.

Held from August 11 to 15, 2025, the camp offered an immersive five-day bilingual learning experience for elementary students, integrating AI-powered teaching robots with STEAM education (Science, Technology, Engineering, Arts, and Mathematics).

Innovative Curriculum Design

The camp centered on the theme of a "Little Octopus Vacuum Cleaner", guided by pedagogical AI agents and supported by IoT-based smart teaching tools. Students learned through:

- Voice-based dialogues with AI robots,
- Gamified tasks and challenges, and
- Hands-on creation activities.

The curriculum followed the 6E Learning Model — *Engage, Explore, Explain, Engineer, Enrich, Evaluate*. Students advanced step by step from understanding motors, batteries, and fans to designing and assembling their own working vacuum cleaner prototypes.

On the final day, a lively competition showcased whose handmade vacuum cleaners could clean the fastest. Students presented their projects, received participation certificates, and proudly brought home their own creations — memorable tokens of their interdisciplinary learning journey.

Pedagogical Significance

The camp's instructional model placed AI teachers at the center, with human teachers acting as facilitators. Children primarily learned and explored with guidance from AI agents, building self-directed learning skills and problem-solving abilities. Teaching assistants provided timely support, ensuring every participant could succeed.

By experiencing how AI, English learning, and STEAM subjects intertwine, students strengthened not only their logical thinking and creativity, but also their language proficiency and collaborative skills in an engaging, story-driven environment.

Reception and Future Directions

The program received enthusiastic feedback from both students and parents. Parents expressed hope that similar camps could be organized more frequently, highlighting the camp's role in fostering joyful, hands-on learning. The principal of Xinsheng Elementary School also praised the outcomes, noting the strong potential for expanding such initiatives on campus to reach more students.

The *AI Robot Teacher × Bilingual STEAM Summer Camp* demonstrates how gamified, story-based pedagogy can effectively cultivate innovation, teamwork, and problem-solving skills. As a model of AI-assisted interdisciplinary education, it sets a benchmark for the future development of STEAM learning in Taiwan.

Upcoming Events

msceis-IWALS International Joint Conference 2025

Date: November 7-8, 2025
Location: Kota Bandung, Indonesia

The msceis–IWALS International Joint Conference 2025 will take place on 7–8 November 2025 in Kota Bandung, Indonesia, organized by National Taiwan Normal University (NTNU) and Universitas Pendidikan Indonesia (UPI).

Initiated by NTNU, the International Workshop on Advanced Learning Sciences (IWALS) celebrates its 11th year, bringing together universities and scholars from around the world. Traditionally hosted in a different country each year, IWALS fosters global collaboration in education and research. In 2025, IWALS will join the Mathematics, Science, and Computer Science Education International Seminar (MSCEIS), with a focus on innovation in STEM education, digital learning, and sustainability.

Conference Themes

- Mathematics, Science & Engineering for Sustainability
- Digital Learning in Science Education
- STEM Education and Technology
- Society 5.0 in Science Education
- Nature, Equity, and Policy in Education

Important Dates

- Full Paper Submission Deadline: 6 October 2025
- Conference Dates: 7–8 November 2025

For details, visit the official conference page .

Upcoming Events

NTNU Sinophone and Taiwan Studies Book Series

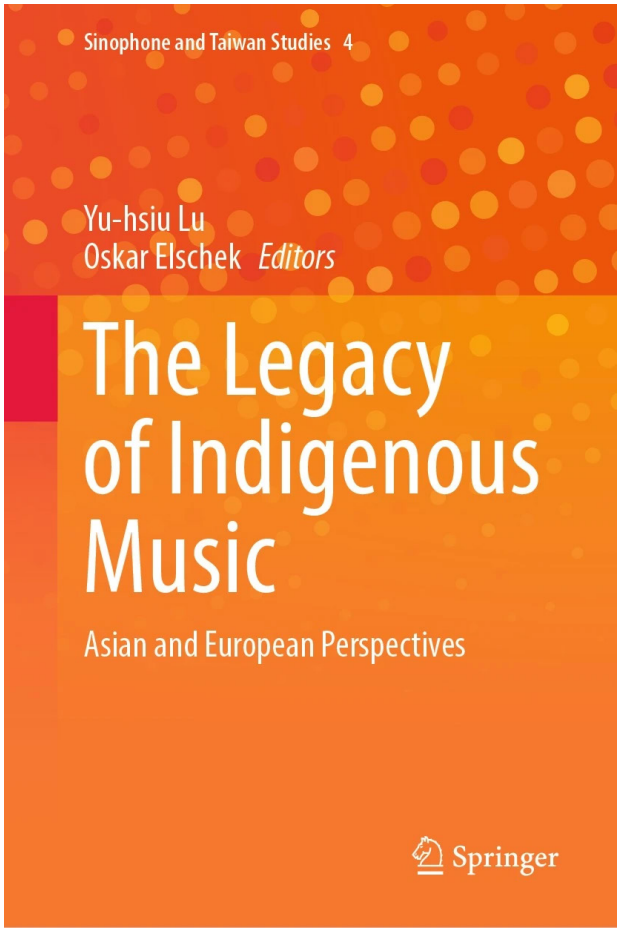
Open for Submissions

Springer

Book series

Sinophone and Taiwan Studies

The Legacy of Indigenous Music



Editors: Yu-hsiu Lu and Oskar Elschek

This book shares essential insights into how indigenous music has been inherited and preserved under the influence of the dominant mainstream culture in Asia and Europe. It illustrates possible ways of handing down indigenous music in countries and regions with different levels of acceptance toward indigeneity, including Taiwan, the Philippines, Malaysia, Turkey, the Czech Republic, Slovakia, the Near and Middle East, Caucasus Mountains, etc. Given its focus, the book benefits researchers who are interested in the status quo of indigenous music around the globe. The macro- and micro-perspectives used to explore related issues, problems, and concerns also benefit those interested in regional ethnomusicology.

The "Sinophone and Taiwan Studies," centered on Taiwan Studies-related humanities and social science research, is open for new book submissions. Edited by Professor Shih Shu-mei of UCLA and Professor Nikky Lin of NTNU, this book series aims to break Sinophone and Taiwan Studies out of old limiting frameworks and methodologies.

Browse the series and download the book proposal form here.

Awards & Honors

Six IRELS Scholars Honored with 2024 NSTC Academic Research Awards

Six scholars from NTNU's Institute for Research Excellence in Learning Sciences (IRELS) have been recognized in the 2024 Academic Research Awards by Taiwan's National Science and Technology Council (NSTC), earning distinction across three prestigious categories.

The honors include:

- Two Distinguished Research Fellows
- Two Outstanding Research Award recipients
- Two Wu Ta-You Memorial Award winners, recognizing early-career scholars under the age of 42 for their research excellence.

The award ceremony was held on April 29, 2025, where NSTC Chairperson Cheng-Wen Wu commended the 2024 awardees for their contributions to national development and to Taiwan's expanding global research presence. This recognition underscores NTNU's enduring commitment to cultivating scholars across generations, advancing both its academic legacy and leadership in research and innovation.

Distinguished Research Fellows

- Yao-Ting Sung, NTNU Executive Vice President and Research Chair Professor in the Department of Educational Psychology and Counseling — honored for pioneering contributions to personalized education and educational reform.
- Ying-Shao Hsu, NTNU Vice President for Research and Development and Chair Professor in the Graduate Institute of Science Education — recognized for influential work on socio-scientific issues and interdisciplinary science education.

Outstanding Research Awards

- Yu-Kai Chang, Chair of the Department of Physical Education and Sport Sciences — for groundbreaking research on the relationship between exercise and cognition.
- Silvia Wen-Yu Lee, Associate Dean of the College of Education — for significant contributions to digital science modeling and innovative approaches in science education.

Wu Ta-You Memorial Awards

• Chen-Wei Liu, Department of Educational Psychology and Counseling — for advancements in psychometric modeling and educational assessment methodologies.

• Ching-Lin Wu, Bachelor's Program in Learning Sciences — for research on creativity and cognitive neuroscience.

Fig. 7. Group photo of NTNU IRELS scholars recognized with the 2024 NSTC Academic Research Awards at the ceremony on April 29, 2025. From right to left: Chen-Wei Liu, Yu-Kai Chang, Silvia Wen-Yu Lee, Yao-Ting Sung, and Ying-Shao Hsu.

NTNU Featured Research Newsletter

International Taiwan Studies Center,NTNU
國際臺灣學研究中心

社會情緒教育與發展研究中心
Social Emotional Education and Development Center

華語文與科技研究中心
Chinese Language and Technology Center

學習科學跨國頂尖研究中心
Institute for Research Excellence in Learning Sciences