

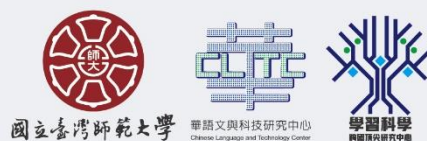
The 8<sup>th</sup> International Workshop on Advanced Learning Sciences

# IWALS 2022

Learning Sciences and Technology

October 13-15, 2022

Conference Room 1, 3<sup>rd</sup> Floor,  
Education Building, National Taiwan Normal University





## About IWALS

IWALS is an international conference organized annually by an international program committee. It attracts a diverse group of multi-disciplinary researchers and practitioners involved in the field of psychology, linguistics, cognitive neuroscience, psychometrics, science education, digital learning, and learning sciences. In the past, IWALS had been held in Finland, the USA, China, Japan, and Taiwan.

- 7th IWALS, University of Jyväskylä, Finland, June 17-19, 2019
- 6th IWALS, University of Pittsburgh, Pittsburgh, PA, USA, June 6-8, 2018
- 5th IWALS, National Taiwan Normal University, Taiwan, July 7-10, 2017
- 4th IWALS, South China Normal University, Guangzhou, P.R. China, June 6-8, 2016
- 3rd IWALS, Tokyo University of Foreign Studies, Tokyo, Japan, August 1-2, 2015
- 2nd IWALS, National Taiwan Normal University, July 16-17, 2014
- 1st IWALS, Pennsylvania USA, Penn State University, October 21-22, 2013

## IWALS 2022

Welcome to the 8th International Workshop on Advanced Learning Sciences (IWALS). Meeting sessions will be held from October 13 to October 15 at National Taiwan Normal University, Taiwan. The workshop includes Keynote Speeches, Invited talks, Symposiums, and Poster sessions. Due to the pandemic, the 8<sup>th</sup> IWALS will be held in both physical and online format.

The theme of this workshop is "Learning Sciences and Technology". Invite scholars in related fields to give speeches and provide an interactive exchange platform for scholars worldwide. We sincerely invite you to participate in the grand event.



## Introduction of the organizer

Characterized by both tradition and innovation, National Taiwan Normal University (NTNU) has long been recognized as one of Taiwan's elite institutions of higher education. Founded in 1922, NTNU was formerly an institution dedicated to teacher education. The university later evolved into a comprehensive university that provides students and scholars with opportunities to study and conduct research in a wide range of fields.



NTNU is committed to pursuing academic excellence, having been established on the philosophy that education is the root of our nation. This commitment is characterized by the many influential educators and researchers it has nurtured over the years. With three campuses in Taipei City and New Taipei City, NTNU offers 63 academic subjects in nine degree-granting colleges. The internationally renowned Mandarin Training Center is also located at NTNU. Each year approximately 1,800 students from over 70 countries take part in language courses offered by the Mandarin Training Center.

Ranking:



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## Conference Schedule

**Date:** October 13-15, 2022

**Venue:** Conference Room 1, Education Building

**[Join the workshop online](#)** (applies to all three days)

[Contact us for help](#)

### Day One: Thursday, October 13, 2022

Time	Activity
10:00-10:30(30mins)	<b>Registration</b>
10:30-11:00(30mins)	<b>Opening Ceremony</b>
11:00-12:00(60mins)	Keynote Speech # 1 <b>online</b> Massive Distance Education in Formal Schooling: Barriers, Challenges and Potential Speaker: <b>Chin-Chung Tsai</b> (National Chair Professor, Dean, School of Learning Informatics, National Taiwan Normal University) Chair: <b>Hsueh-Chih Chen</b> (Professor, Department of Education Psychology and Counseling, National Taiwan Normal University)
12:00~13:00 (60mins)	<b>Lunch break</b>
13:00~14:00(60mins)	Keynote Speech # 2 <b>physical</b> The Literate Brain: An Update on Neuroimaging Studies of Language Development, Reading, and Reading Disability Speaker: <b>Kenneth Pugh</b> (President and Director of Research, Senior Scientist, Yale University / Haskins Labs) Chair: <b>Ovid J.L. Tzeng</b> (Distinguished Research Fellow, Institute of Linguistics, Academia Sinica)

Time	Activity
14:00~14:30 (30mins)	<p>Invited Talk #1 <b>online</b></p> <p>Developing STEM Education Competencies for Science Teachers in Vietnam</p> <p>Speaker: <b>Nguyen Van Hien</b> (Vice President, Hanoi National University of Education)</p> <p>Chair: <b>Fang-Ying Yang</b> (Research Chair Professor, Graduate Institute of Science Education, National Taiwan Normal University)</p>
14:30~15:00 (30mins)	<p>Invited Talk #2 <b>online</b></p> <p>STEM Education and Student's Sustainable Lifestyle</p> <p>Speaker: <b>Ari Widodo</b> (Faculty of Mathematics and Science Education, Indonesia University of Education)</p> <p>Chair: <b>Lee, Jun Ren</b> (Associate Professor, Department of Education Psychology and Counseling, National Taiwan Normal University)</p>
15:00-15:30(30mins)	<p><b>Refreshment Break</b></p>
15:30-16:00(30mins)	<p>Invited Talk #3 <b>physical</b></p> <p>Linguistic Typology and the Acquisition of Chinese: Insights from Learner Corpora</p> <p>Speaker: <b>Keiko Mochizuki</b> (Professor of Linguistics, Graduate School of Global Studies, Tokyo University of Foreign Studies)</p> <p>Chair: <b>Jia-Fei Hong</b> (Professor, Department of Chinese as a Second Language, National Taiwan Normal University)</p>
16:00-16:30 (30mins)	<p>Invited Talk #4 <b>physical</b></p> <p>Developing a New Chatbot for ESL Learners Based on OpenAI</p> <p>Speaker: <b>Chen, Hao-Jan Howard</b> (Distinguished Professor, Department of English, National Taiwan Normal University)</p> <p>Chair: <b>Keiko Mochizuki</b> (Professor of Linguistics, Graduate School of Global Studies, Tokyo University of Foreign Studies)</p>

Time	Activity
16:30~17:30 (60mins)	<p>Keynote Speech # 3 <b>online</b></p> <p>Where is Reading Research Going? A-35-years Perspective.</p> <p>Speaker: <b>Ram Frost</b> (Professor of Psychology, Hebrew University of Jerusalem, Israel / Haskins Labs)</p> <p>Chair: <b>Lee, Jun Ren</b> (Associate Professor, Department of Education Psychology and Counseling, National Taiwan Normal University)</p>
17:30~18:30 (60mins)	<b>Welcome Reception</b>

## Day Two: Friday, October 14, 2022

Time	Activity
08:30~09:00 (30mins)	<b>Registration</b>
09:00-10:00 (60mins)	<p>Keynote Speech #4 <b>online</b></p> <p>How Much Does a Learner's First Language or Writing System Matter in Reading a Second Language?</p> <p>Speaker: <b>Charles Perfetti</b> (Distinguished University Professor, University of Pittsburgh, Department of Psychology Co-Director, Pittsburgh Science of Learning Center)</p> <p>Chair: <b>Li-Yun Chang</b> (Associate Professor, Department of Chinese as a Second Language, National Taiwan Normal University)</p>
10:00–10:30 (30mins)	<b>Refreshment Break</b>
10:30~12:00 (90mins)	<p>Symposium#1 <b>physical</b></p> <p>Sport Science Research for Improving Health and Sport Performance</p> <p>Speakers:</p>



Time	Activity
	<ul style="list-style-type: none"> <li>• <b>Tsung-Min Hung</b> (Department of Physical Education and Sport Sciences, National Taiwan Normal University)</li> <li>• <b>Philip X. Fuchs</b> (Department of Athletic Performance, National Taiwan Normal University)</li> <li>• <b>Shao-Hsi Chang</b> (Department of Physical Education and Sport Sciences, National Taiwan Normal University)</li> <li>• <b>Wen-Bin Lin</b> (Physical Education Center, Taipei National University of the Arts)</li> <li>• <b>Yu-Kai Chang</b> (Department of Physical Education and Sport Sciences, National Taiwan Normal University)</li> </ul> <p>Chair: <b>Tsung-Min Hung</b> (Research Chair Professor, Department of Physical Education and Sport Sciences, National Taiwan Normal University)</p>
12:00~13:00 (60mins)	<b>Lunch break</b>
12:30~13:15 (45mins)	Poster Session#1 <b>online</b>
13:15-14:00 (45mins)	Poster Session#2 <b>online</b>
14:00-15:30 (90mins)	<p>Symposium#2 <b>physical</b></p> <p>The Road not Taken: IRELS at NTNU</p> <p>Speakers:</p> <ul style="list-style-type: none"> <li>• <b>Chin-Chung Tsai</b> (National Chair Professor, Dean, School of Learning Informatics, National Taiwan Normal University)</li> <li>• <b>Fang-Ying Yang</b> (Graduate Institute of Science Education, National Taiwan Normal University)</li> <li>• <b>Hsien-Sheng Hsiao</b> (Department of Technology Application and Human Resource Development, National Taiwan Normal University)</li> <li>• <b>Po-Hsi Chen</b> (Department of Education Psychology and Counseling, National Taiwan Normal University)</li> </ul>

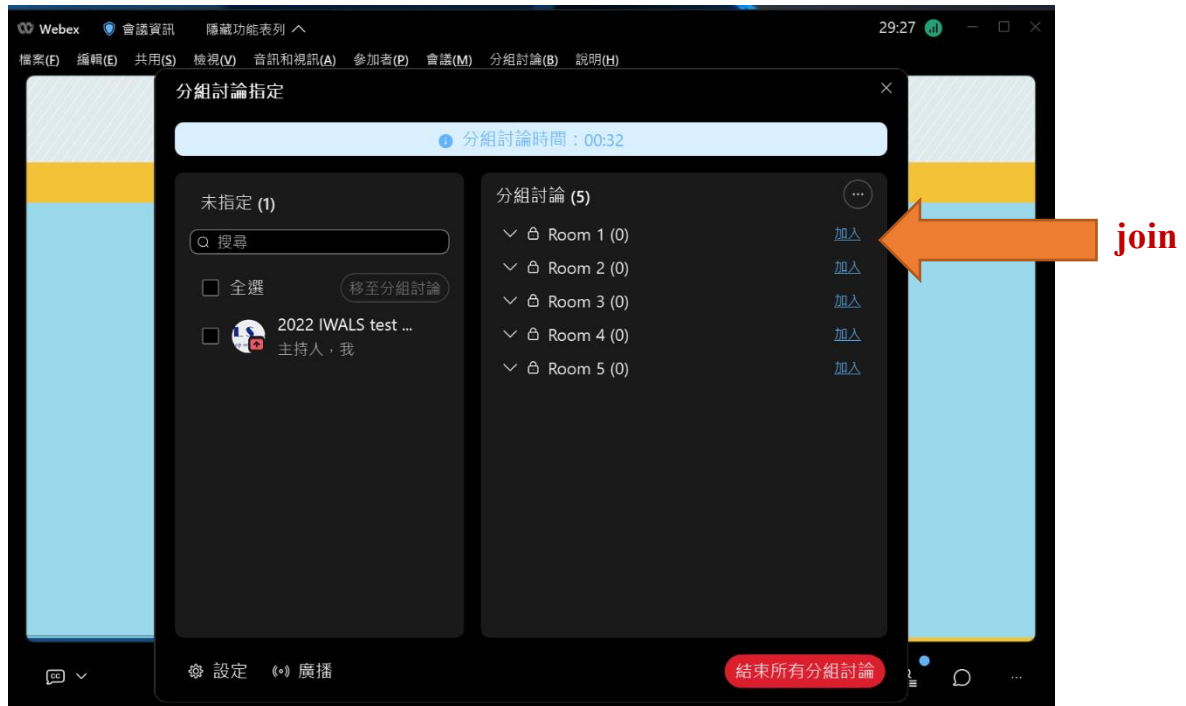
Time	Activity
	<ul style="list-style-type: none"> <li>• <b>Yi-Fang Hsu</b> (Department of Education Psychology and Counseling, National Taiwan Normal University)</li> <li>• <b>Chun-Yen Chang</b> (Chair Professor and Director of the Science Education Center, National Taiwan Normal University)</li> </ul> <p>Chair: <b>Chun-Yen Chang</b> (Chair Professor and Director of the Science Education Center, National Taiwan Normal University)</p>
15:30~16:00 (30mins)	<b>Refreshment Break</b>
16:00-16:30 (30mins)	<p>Invited Talk #5 <b>physical</b></p> <p>Bilingual Education – Distinctions of Terms and Latest Developments</p> <p>Speaker: <b>Jim McKinley</b> (Applied Linguistics, University College London)</p> <p>Chair: <b>Chun-Yen Chang</b> (Chair Professor and Director of the Science Education Center, National Taiwan Normal University)</p>
16:30-17:30 (60mins)	<p>Keynote Speech #5 <b>physical</b></p> <p>Solving the Grand Challenges through Interdisciplinary Contextualization</p> <p>Speaker: <b>Chun-Yen Chang</b> (Chair Professor and Director of the Science Education Center, National Taiwan Normal University)</p> <p>Chair: <b>Chin-Chung Tsai</b> (National Chair Professor, Dean, School of Learning Informatics, National Taiwan Normal University)</p>

## Day Three: Saturday, October 15, 2022

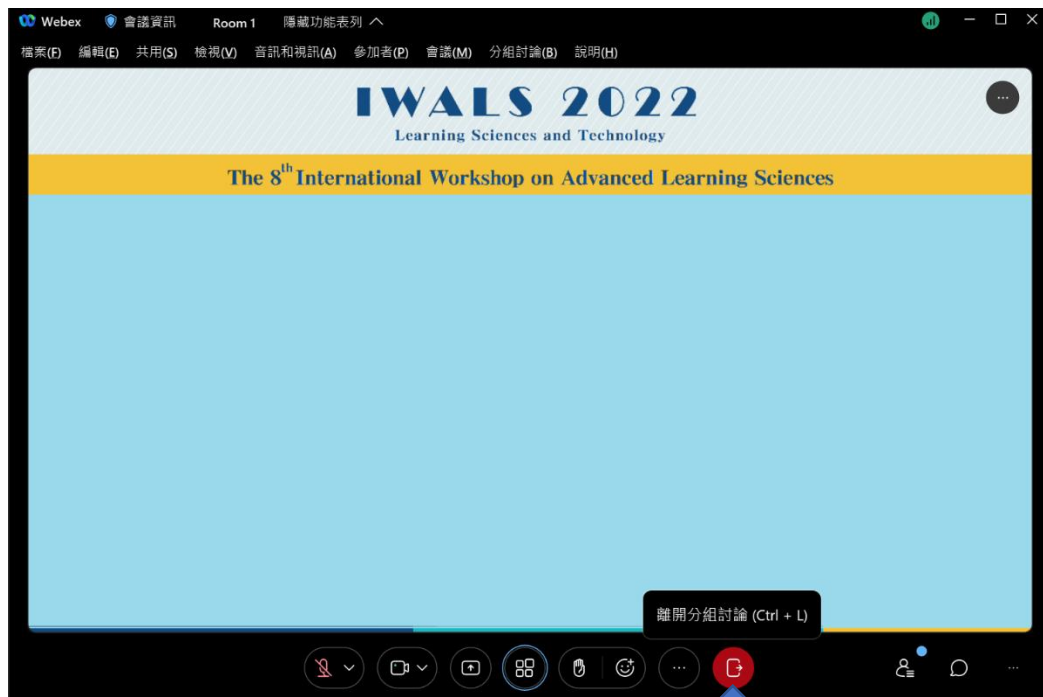
Time	Activity
8:30-09:00 (30mins)	<b>Registration</b>
09:00-9:30 (30mins)	Invited Talk #6 <b>online</b> Addressing Diversity and Cultural Awareness in the Teacher Workforce -- The Case of Pennsylvania, USA Speaker: <b>David Monk</b> (Professor Emeritus of Education, The Pennsylvania State University) Chair: <b>Pei-Ying Chen</b> (Professor, Department of Education, National Taiwan Normal University)
09:30–10:00 (30mins)	Invited Talk # 7 <b>physical</b> Supporting Students Digital Learning of Key STEM Concepts: The Cornerstone Maths and ScratchMaths Approaches Speaker: <b>Alison Clark-Wilson</b> (UCL Institute of Education, University College London) <b>Piers Saunders</b> (UCL Institute of Education, University College London) Chair: <b>Chun-Yen Chang</b> (Chair Professor and Director of the Science Education Center, National Taiwan Normal University)
10:00~10:30 (30mins)	<b>Refreshment Break</b>
10:30~11:30 (60mins)	Keynote Speech #6 <b>physical</b> Moving Attention to the Prevention of Learning Difficulties. Speaker: <b>Heikki Lyytinen</b> (Emeritus professor of Psychology, UNESCO Chair on Inclusive Literacy for All, University of Jyväskylä) Chair: <b>Yao-Ting Sung</b> (Chair Professor, and Executive Vice President, National Taiwan Normal University)
11:30-12:00 (30mins)	<b>Closing Ceremony</b>

## How to Join Online Poster Presentation Room

When the poster discussion session starts, you will see the following message. You can freely choose the discussion room you want to join and click to "join."



To leave the current session, click "Leave Session. "



## Poster Session#1

Date: Friday, October 14, 2022

Time: 12:30-13:15

[Webex Link](#)

Webex Chat Room#	Topic	Authors	Poster Presentation
1	The Role Of Application Of Immersive Virtual Learning (IVL) On Students' Understanding, Beliefs, And Desire To Give Action On Climate Change	Asita Al Mufida, Ari Widodo, Rini Solihat	<a href="#">Poster</a>
			<a href="#">Video</a>
2	Associations of learning disorders & access to educational services among incarcerated adults in the United States of America	Brandy F. Henry & Joy Grayl	<a href="#">Poster</a>
			<a href="#">Video</a>
3	Current Trend of Blended Learning Research in Biology Education: A Systematic Review of Literature From 2016 to 2022	Heru Setiawan , Hertien K. Surtikanti , Riandi	<a href="#">Poster</a>
			<a href="#">Video</a>
4	The Study on the Development of the “Model of Behavior Scale ” and the "Creativity Component Scale"	Meng-Jung Chuang	<a href="#">Poster</a>
			<a href="#">Video</a>
5	Raising children's chemical safety awareness with immersive virtual lab experience	Ting Kai Ting	<a href="#">Poster</a>
			<a href="#">Video</a>
6	The Implication of Integrating Chinese Key-Image Strategy into Chinese Character Writing Books for CSL/CFL Learners	Chia-Yun Lee 、 Hsueh-Chih Chen 、 Zhen-Xing Lin 、 Li-Yun Chang	<a href="#">Poster</a>
			<a href="#">Video</a>
7	A Study of the eMPower Platform on Chinese Character Learning Effectiveness of Taiwanese New Immigrant Children in Primary Schools	Hsiang-Yu, Hsiung 、 Pin-Lun, Juan 、 Yao-Ting Sung 、 Zhen-Xin, Lin	<a href="#">Poster</a>
			<a href="#">Video</a>

<b>Webex Chat Room#</b>	<b>Topic</b>	<b>Authors</b>	<b>Poster Presentation</b>
8	The Effect of Chinese Key-Image Strategy and the Character-to-Word Integration to Support Chinese Vocabulary Learning: An In-vivo Study	Li-Yun Chang Yueh Cho Colin Kristianti Hsueh-Chih Chen	<a href="#">Poster</a>
			<a href="#">Video</a>
9	Continuous Rating Scale Analytics: A Tool for Rescaling Continuous and Discrete Data to Interval Scores	Yao-Ting Sung, Wei-Hung Yang , I-Husn Liu, and Yeh-Tai Chou	<a href="#">Poster</a>
			Video
10	Patterns of Visual Behavior for College Students When Reading High- and Low-cohesion Science Text: An Eye-tracking Study	Tzu-Ning Wang , Yu-Cin Jian	<a href="#">Poster</a>
			<a href="#">Video</a>
11	Teacher Professional Development using technology-ethnoscience to improve TPACK science teachers	Yohanes Freadyanus Kasi , Yohanes Freadyanus Kasi, Ari Widodo, Achmad Samsudin, Riandi	<a href="#">Poster</a>
			<a href="#">Video</a>

## Poster Session#2

Date: Friday, October 14, 2022

Time: 13:15-14:00

[Webex Link](#)

Webex Chat Room#	Topic	Authors	Poster Presentation
12	The Professional Development Process of Female Teachers of Living Technology-The Viewpoint of Sociobiology	Chou, Chia-hui	<a href="#">Poster</a>
			<a href="#">Video</a>
13	Literacy-related cognitive correlates of Chinese oral reading fluency at one-character word level and text level	Chien-Chih Tseng, Li-Yun Chang, Hsueh-Chih Chen	<a href="#">Poster</a>
			<a href="#">Video</a>
14	Exploring the Impacts of Subtitles, Labels and Prior Knowledge on Redundancy Effect in Video Assisted Learning	Kuo, Chih-Hsuan, Liu, Tzu-Chien, Lin, Yi-Chun	<a href="#">Poster</a>
			<a href="#">Video</a>
15	Effects of vocabulary and grammar acquisition and dictionary use on writing tasks	Sho Fukuda	<a href="#">Poster</a>
			<a href="#">Video</a>
16	Science Reading in Second Language: A Comparison of Global and Local Comprehension Results of EFL Readers with Different Language Proficiency	Tzu-Hsuan Chen 、 Yu-Cin Jian	<a href="#">Poster</a>
			<a href="#">Video</a>
17	Have a Good Laugh about Life: The Effects of a Humor Intervention on Sense of Humor, Positive Emotions and Learning Ability	Yu-Hsiu Liao 、 Mei-Fang Lee 、 Hsueh-Chih Chen	<a href="#">Poster</a>
			<a href="#">Video</a>
18	How Dialogic Reading Executive Function Development: A Serial Mediation Model Analysis	Shan Shan Chou 、 Shinmin Wang	<a href="#">Poster</a>
			<a href="#">Video</a>

Webex Chat Room#	Topic	Authors	Poster Presentation
19	Using the 6E model combined with self-efficacy strategies to explore STEM career interests and learning performance in a high school AIOT hands-on activity	Hsiao, Hsien-Sheng · Tsao, Yung-Chiau · Chung, Guang-Han · Chen, Jheng-Han	Poster Video
20	Student Enthusiasm in Fieldwork Activities as Valuable First Step for Implementation of Research Skills	Ulfi Faizah · Nuryani Y. Rustaman · Yayan Sanjaya · Ana R. Wulan · Reni Ambarwati · Dwi A. Rahayu and Roflza Yolanda	<a href="#">Poster</a> <a href="#">Video</a>
21	Investigating the reliabilities of the fine-grained and the coarse-grained measurement tools	Yao-Ting Sung, Wei-Hung Yang, I-Husn Liu, and Yeh-Tai Chou	<a href="#">Poster</a> Video
22	Evaluating the different performance on vocabulary learning among college students by presenting test items in L1 and L2	Meng-Huan Li, Yu-Cin Jian	<a href="#">Poster</a> <a href="#">Video</a>



# Rules of Poster Presentation

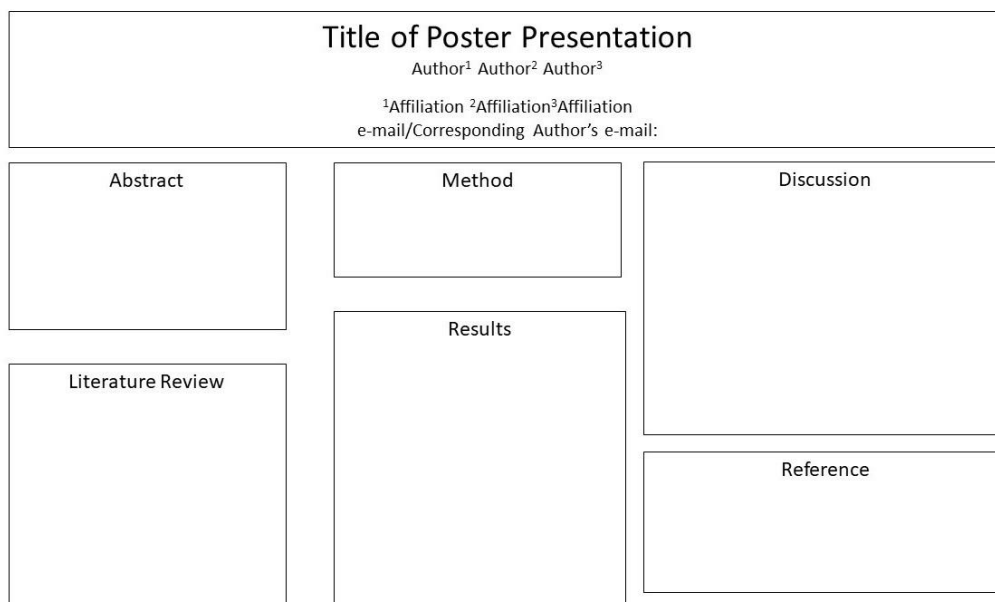
In response to the COVID-19 epidemic in Taiwan, this workshop's poster papers will be published online. Participants are requested to cooperate in the following matters.

1. For poster posters, please read the Webex operation tutorial first.
2. During the conference, the presenters of each session are kindly requested to enter the online link 5 to 10 minutes in advance and confirm the operation status of your network, microphone, and video camera.
3. After the abstract is accepted, please upload a pre-recorded 5-minute presentation video as well as your poster (in PDF) to the designated cloud space (to be announced) before October 10.
4. The videos and posters will be available on our website for all attendees to view during the conference. In addition, the authors are required to go ONLINE at the time specified by the workshop and conduct Q&A discussions with the attendees.
5. Abstracts and posters must be in English. However, your pre-recorded 5-minute presentation video and Q&A session can be presented/conducted either in English or Chinese.
6. Poster Format

To match the size of an average computer screen, the format/size of the poster needs to fit a 16:9 aspect ratio (in a square) as well as a height of 67.5 cm and a width of 120 cm in actual size.

Abstract, research methods, results, and discussion are requirements for your poster's content, so please include them in your file. Publishers are requested to upload the pdf file of the poster and the mp4 file of the video within 5 minutes to the cloud folder before October 10 (Monday).

Below is an example on how to organize the content of your poster:



# Get started with Webex Meetings for attendees

## Formal online link (applies to all three days)

<https://ntnu.webex.com/ntnu/j.php?MTID=m54dfdc1bc9427e58e88f9b8b7239e7ce>

1. The online conference software used in this workshop is "Webex."
2. Click the link to join the meeting.
3. If the publisher wants to share the screen, click "Share" in the options bar below.



# Keynote Speakers



## **Heikki Lyytinen**

Emeritus professor of Psychology, UNESCO Chair on Inclusive Literacy for All, University of Jyväskylä

As UNESCO Chair on Inclusive Literacy Learning for All (2015-19 and 2019-2021) Heikki Lyytinen focuses on Graphogame research to show that this digital learning environment succeeds in helping children globally to become literate, ie. to overcome biological/genetic bottlenecks and compromised opportunities to receive sufficient instruction.



## **Charles Perfetti**

Distinguished University Professor, University of Pittsburgh, Department of Psychology Co-Director, Pittsburgh Science of Learning Center

Pro. Charles Perfetti is the most influential in the area of reading. He was awarded the Distinguished Scholar award by the American Educational Research Association (AERA) Special Interest Group (SIG): Research in Reading and Literacy for his outstanding contributions to research in reading and literacy.



## **Kenneth Pugh**

President and Director of Research, Senior Scientist,  
Yale University / Haskins Labs

Pro. Kenneth Pugh is a cognitive neuroscientist and experimental psychologist who is best known for his work on the neural, behavioral, and cognitive underpinnings of reading and other cognitive activities. He was among the first scientists to use functional magnetic resonance imaging (fMRI) to reveal brain activity associated with reading and reading disabilities.



## **Ram Frost**

Professor of Psychology, Hebrew University of Jerusalem,  
Israel / Haskins Labs

Pro. Ram Frost is a world-leading expert on cross-linguistic differences in reading. His research on reading in Hebrew has changed the prevalent anglocentric theoretical perspectives of reading research and has changed the educational system of Israel and its methods of teaching reading.



## **Chin-Chung Tsai**

Dean, School of Learning Informatics,  
National Taiwan Normal University, Taiwan

Prof. Chin-Chung Tsai is currently a Chair Professor and Dean for School of Learning Informatics, National Taiwan Normal University, Taipei, Taiwan. He is also the Director of the Institute for Research Excellence in Learning Sciences, National Taiwan Normal University. Since July 2009, he has been appointed as the Co-Editor of Computers & Education (SSCI, IF= 5.296, rank 4/263). He is also currently served as the Editor of International Journal of Science Education (indexed in SSCI, one among the three core journals in science education). His research interests deal largely with constructivism, epistemic beliefs, and various types of technology-enhanced (such as VR, AR, game) instruction. He has a publication record of more than 300 SSCI papers in recent 20 years.



## **Chun-Yen Chang**

Chair Professor and Director of the Science Education  
Center, National Taiwan Normal University, Taiwan

Pro. Chun-Yen Chang's research interests mainly cover science education, digital learning, interdisciplinary learning, and science communication. In 2003, 2009, and 2012, he was awarded the National Science Council Outstanding Research Award (Science Education), Executive Yuan. The "CloudClassRoom (CCR)" developed by Prof. Chang's team has been widely promoted.

## **Keynote Speech # 1**

Massive distance Education in formal schooling: barriers,  
challenges and potential

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**Chin-Chung Tsai**

(Dean, School of Learning Informatics, National Taiwan Normal  
University, Taiwan)

# **Massive distance Education in formal schooling: barriers, challenges and potential**

Chin-Chung Tsai

Dean, School of Learning Informatics, National Taiwan Normal University, Taiwan

The Covid-19 pandemic creates an urgent and unexpected happening of massive distance education worldwide. In particular, in most countries, distance education was rarely implemented in k-12 schools before as teachers and learners were used to interact with each other in face-to-face settings. Such massive distance education not only causes challenges for online learning platforms/systems but also for governments, parents, teachers and students. In this talk, I will share some of my previous research findings as well as my own observations of some possible barriers of such massive distance education especially from the perspectives of teachers. The challenges by the governments, system providers and researchers will also be discussed. Finally, I will propose some potential directions and applications in terms of practice and academic research.

## **Keynote Speech # 2**

The Literate Brain: An Update on Neuroimaging Studies of  
Language Development, Reading, and Reading Disability

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**Kenneth Pugh**

(President and Director of Research, Senior Scientist, Yale  
University / Haskins Labs)



# **The literate brain: An update on neuroimaging studies of language development, reading, and reading disability**

Kenneth R. Pugh

President and Director of Research, Haskins Laboratories,  
Professor, University of Connecticut, Associate Professor Yale University

Good reading skills are crucial for success in the modern world. Reading disability (RD) is characterized as a brain-based difficulty in acquiring fluent decoding skill, usually associated with problems in operating on the *phonological structures of language*. I will review research from our lab and others which indicates that atypically developing RD children fail to develop key left hemisphere brain “circuits” that, in typically developing (TD) readers, come online to support skilled reading. New discoveries on how genetic, neurobiological, and environment factors impact early language development and later reading outcomes will be discussed in this context. I will also present an overview of the latest research from our lab on the brain-basis of treatment and remediation of language and reading difficulties (in multiple languages), including new research using multi-modal brain imaging during learning with the larger goal of tailoring instruction to individual differences in brain organization. Finally, I will discuss recent research from our lab and others on how the COVID pandemic has impacted reading skills and how we can design new learning environments to address the expected reading losses.

## **Keynote Speech # 3**

Where is Reading Research Going? A-35-years Perspective.

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**Ram Frost**

(Professor of Psychology, Hebrew University of Jerusalem, Israel  
/ Haskins Labs)

## **Where is reading research going? A-35-years perspective**

Ram Frost

Department of Psychology, The Hebrew University and Haskins Laboratories.

In this talk I will review the big questions of reading research, focusing on what should a theory of reading expertise look like. Discussing the various theoretical perspectives of reading proficiency, I will outline the blueprint of a novel approach that draws on insights from statistical learning research. A statistical learning theory of proficient reading assumes that reading experience leads to a deep assimilation of the statistical structure of a writing system, enabling effective predictions on-the-fly, thus facilitating eye-movement behavior. From a cross-linguistic perspective, it highlights the different statistical regularities embedded in writing systems, specifying how these regularities can be learned and processed by a neurobiologically-constrained computational system. This new perspective reshuffles the cards in the taxonomy of writing systems and generates a large set of novel predictions regarding cross-linguistic differences in reading behavior.

## **Keynote Speech # 4**

How Much Does a Learner's First Language or Writing System Matter in Reading a Second Language?

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**Charles Perfetti**

(Distinguished University Professor, University of Pittsburgh,  
Department of Psychology Co-Director, Pittsburgh Science of  
Learning Center)

# **How Much Does a Learner's First Language or Writing System Matter in Reading a Second Language?**

Charles Perfetti, Lin Chen, and Gaisha Oralova  
University of Pittsburgh

Learning Sciences research has demonstrated that a learner's background knowledge has a profound influence on the process and outcome of new learning. In the case of learning a new language, the learner's first language and its writing system may confer benefit (transfer) or cost (interference) to learning to read in the second language. But to what extent do these background effects linger after the second language has been well learned? We address this question through an ongoing study of college students' English reading comprehension that compares English first-language speakers with speakers of three different background languages: Chinese, Spanish, and Korean. We examined reading comprehension through the application of statistical language models to short authentic texts, taking behavioral and ERP measures of word-word-by word reading. The overall picture so-far shows a surprising uniformity across languages in the factors that influence the reading of English texts. Some language background factors do matter; but the larger implication is that success in skilled reading of a second language is more dependent on the reader's experience with that language than on the reader's first language. To speculate on a learning sciences generalization, skilled performance depends on the current state of knowledge rather than previous states.

## **Keynote Speech # 5**

Solving the Grand Challenges through Interdisciplinary  
Contextualization

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**Chun-Yen Chang**

(Chair Professor and Director of the Science Education Center,  
National Taiwan Normal University, Taiwan)

# **Solving the Grand Challenges through Interdisciplinary**

## **Contextualization**

Chun-Yen Chang, Ph.D.  
NTNU Chair Professor  
Director of Science Education Center

Over the past decade, genetic and neuroscience research have provided some of the most exciting breakthroughs for cognitive and educational science. Rather than merely providing a powerful means for exploring the mechanism of human behavior, the integration of multiple disciplines (Education, Cognitive psychology, Neuroscience, and Genetic or molecular biology studies) can serve researchers now further their own research while deriving meaningful implications and/or practices for learning and instruction. In this presentation, I would like to present our attempt in solving grand challenges through interdisciplinary research, briefly review related theories, and present our work in exploring the associations between genotypes and student cognitive abilities/science achievement. Our ultimate goal is to integrate different research fields with aims of not only exploring the mechanism of learning and behavior, but more importantly, providing instructional approaches (施教) and learning strategies to best fit with students' aptitudes or characteristics (因材施教) based on the interactional effects of ECNG (Education, Cognition, Neuroscience, and Gene).

Keywords: Education, Cognition, Neuroscience, and Gene

## **Keynote Speech # 6**

Moving Attention to the Prevention of Learning Difficulties

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**Heikki Lyytinen**

(Emeritus professor of Psychology, UNESCO Chair on Inclusive Literacy for All, University of Jyväskylä)



## **Moving attention to the prevention of learning difficulties**

Heikki Lyytinen, Unesco Chair on Inclusive Literacy to All & prof. of Developmental Neuropsychology (emeritus), Jyväskylän yliopiston, Finland

This presentation makes an attempt to open the mystery of dyslexia and reasons as well as bottlenecks which tend to compromise children's acquisition of full literacy – the mean goal of reading (reflected in PISA). The relevant results of my research during and after the Jyväskylä Longitudinal study of Dyslexia (JLD, which followed children with and without familial risk for dyslexia from birth to adulthood) will be summarized.

The main emphasis is given to ways how most children can be helped to acquire full literacy by using optimal ways the digital tools based on our GraphoLearn technology ([grapholearn.info](http://grapholearn.info)) and Comprehension Game (CG, see [comprehensiongame.info](http://comprehensiongame.info)). Attempt is made to document that this is true concerning learners of most widely spoken languages including some African ones, one of which the empirical validation of the efficiency of these tools has been most recently focused. To learners who have acquired basic reading skills the CG can offer help independent of e.g. age, language, orthography and background knowledge everywhere where they can connect their Android, Apple or Windows digital tools to internet.

## **Invited Talk # 1**

Developing STEM Education Competencies for Science Teachers  
in Vietnam

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**Nguyen Van Hien**

(Vice President, Hanoi National University of Education)

# **Developing STEM education competencies for science teachers in Vietnam**

Nguyen Van Hien  
Hanoi National University of Education

Science, Technology, Engineering, Mathematics (STEM) Education is a new education trend in the world. Nevertheless, it is recently introduced into the formal education system in Vietnam. This scenario requires effective ways to develop STEM competencies for science teachers in Vietnam. Besides, in reality, there are common confusions about STEM education that Vietnamese science teachers face, such as STEM is coding and programming; STEM is expensive equipment; STEM is fun, hands-on activities only... And these concerns become barriers for science teachers implementing STEM lessons in their daily teaching. Hence, our research questions are: What are the STEM education competencies for the Vietnamese science teacher? How to develop STEM education competencies for science teachers in Vietnam conditions? Based on literature reviews, an initial framework of STEM education competencies for Vietnamese science teachers, which includes three main aspects, has been built up. This framework becomes the basement for some suggestions to develop STEM education competencies for both pre-service and in-service science teachers in Vietnam.

*Keywords: STEM education, STEM education competencies, teacher professional development.*

## **Invited Talk # 2**

STEM Education and Students' Sustainable Lifestyle

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**Ari Widodo**

(Universitas Pendidikan Indonesia, Bandung - Indonesia)

## **STEM Education and Students' Sustainable Lifestyle**

Ari Widodo

Universitas Pendidikan Indonesia, Bandung - Indonesia

Education plays a central role in achieving Sustainable Development Goals (SDGs). Educating children about the importance of sustainability and developing children's sustainable lifestyles could be the ultimate goals of Education for Sustainable Development (ESD). To have a sustainable lifestyle, a person needs to be literate in science and technology. Therefore, STEM education can play an important role in promoting students' sustainable lifestyles. STEM education and ESD can be mutually reciprocal. Understanding sustainability issues and having a sustainable lifestyle shape students' minds when they think of technological solutions while working on STEM projects. Conversely, STEM competencies allow students to develop more sustainable technology. Since STEM education and ESD are closely related and have reciprocal effects, both subjects are preferably taught as an integrated subject rather than as two different subjects. In the absence of possibility to introduce the two as a school subject, they can be integrated into the science subject. However, there are a couple consequences that need to be considered. Firstly, the existing science curriculum needs to be revised to include STEM and ESD. Secondly, science teachers need to be trained with strategies to teach STEM and ESD in the science subject.

### **Invited Talk # 3**

Linguistic Typology and the Acquisition of Chinese: Insights from  
Learner Corpora

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**Keiko MOCHIZUKI**

(Tokyo University of Foreign Studies)

# Linguistic Typology and the Acquisition of Chinese: Insights from Learner Corpora

Keiko MOCHIZUKI,  
(Tokyo University of Foreign Studies)

We will explore how a linguistic typology in learners' native languages (L1) affect second language acquisition through the use of following learner corpora:

“Tokyo University of Foreign Studies and National Taiwan Normal University Learners' Error Corpora of / English / Chinese/ Japanese Searching Platform”

<https://corpus.icjs.jp/>

We will focus on the second language acquisition of three grammatical categories in Chinese:

(1) Epistemic Modality (realis/ irrealis) in Chinese: the atelic auxiliary verb “huì”.

(2) Resultative compound verbs expressing telicity:

<-到 dào>, <-成 chéng> and <-完 wán>, which appear after activity verbs.

(3) Determiner Phrase (DP): determiner “One(一) + Classifier + Noun Phrase”.

Our findings are even CEFR B2 level advanced Japanese L1 learners tend to lack

(1) the atelic auxiliary verb “huì”,

(2) Resultative compound verbs expressing telicity and

(3) “One + Classifier + Noun Phrase” while CEFR B2 level English L1 learners tend to overuse all three forms.

On the other hand, English L1 learners tend to treat the “ONE + Classifier” as an English Determiner, i.e. indefinite article “a/an” although Chinese “ONE + Classifier” does not appear in an atelic event.

This contrast suggests that these difficulties in learning telicity for Japanese L1 learners are due to a typological difference in cognition: Chinese is a “bounded-cognition prominent” type language while Japanese is an “unbounded-cognition prominent” type language. This striking contrast between Japanese L1 and English L1 learners are due to the learner’s L1 typology. In Japanese, a tense system “Past - TA/Nonpast-RU ” is grammatically obligatory, more prominent than the epistemic modality “realis/irrealis” and “perfective/ imperfective” system. In addition, Japanese Noun Phrase has no determiner “a/an, the”, “this/that/ my/your/~’s”.



## **Invited Talk # 4**

Developing a New Chatbot for ESL Learners Based on OpenAI

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**Howard Hao-Jan Chen**

(English Department, National Taiwan Normal University)

## **Developing a New Chatbot for ESL Learners Based on OpenAI**

Howard Hao-Jan Chen  
English Department, National Taiwan Normal University  
hjchenntnu@gmail.com

Even though there are many different technologies that can help with second language learning, creating effective chatbots has long been a key area of study for computer-assisted language learning. Because if we can create a decent chatbot, it should be of great assistance to people learning a second language. Different types of chatbots have been created over the years by computer-aided language learning researchers at various times. Additionally, chatbot technology is continually developing. AIML is one of the most influential technologies used by experts. Alice, Jabberwacky, and Mitsuku/Kuki are just a few illustrative AIML chatbots. Experts created these intriguing chatbots using the AIML programming language. However, it is often difficult to quickly expand these AIML bots. Thus, the more recent chatbots employ a large knowledge database and incorporate artificial intelligence techniques. Amazon's well-known Alexa prize competition is encouraging more institutions around the world to create more potent bots, which will help to create better social bots. The natural language processing team at Stanford University is one of the leaders, and they make their complete chatbot codes publicly available. This fantastic social bot is available at the Chirpy Cardino website. More recently, researchers hope to harness the massive data in OpenAI to create stronger chatbots. Although it is very challenging to maintain good control over the massive amount of open AI data, the open AI database helped us create new chatbots with better conversational competence. Additionally, as compared to previous chatbots, the new chatbots not only produce smooth interactions but also respond with more

relevant and meaningful responses. These chatbots will become excellent tutors if we can further incorporate voice synthesis and speech recognition technology. We expect that the new OpenAI and other huge databases will help various researchers around the world develop more robust chatbots for second and foreign language learning.

## **Invited Talk # 5**

Bilingual education – distinctions of terms and latest  
developments

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**Jim McKinley**

(Applied Linguistics, University College London)

## **Bilingual education – distinctions of terms and latest developments**

Jim McKinley

(Applied Linguistics, University College London)

Bilingual education has evolved from early conceptions of immersion to a wide range of curricular practices and designs. In this talk, I will provide an overview of the various terms used in the broad area of English bilingual education, including English medium instruction (EMI), content and language integrated learning (CLIL), English as a foreign language, and all the terms that fall between, as we understand them today. I will then draw on more recent concepts such as ‘internationalization at home’ and the most current models in bilingual education. The most recent research developments attempting to bring together this broad spectrum will also be addressed before moving to some key challenges that continue in bilingual education. I will close the talk with some implications for bilingual education in Taiwan.

## **Invited Talk # 6**

Addressing Diversity and Cultural Awareness in the Teacher  
Workforce -- The Case of Pennsylvania, USA

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**David H. Monk**

(Professor and Dean Emeritus, College of Education, Penn State  
University)

# **Addressing Diversity and Cultural Awareness in the Teacher Workforce -- The Case of Pennsylvania, USA**

David H. Monk  
Professor and Dean Emeritus  
College of Education  
Penn State University

There are longstanding discrepancies in the representation of different ethnic and racial groups in the student and teacher populations in the United States. The student population is increasingly diverse while the teacher population is largely white and female. In Pennsylvania, the discrepancies are even larger than in the United States as a whole. For example, in Pennsylvania in 2020-21, nearly half of schools and more than a third of school districts had zero teachers of color. The discrepancies in Pennsylvania are also widening. These discrepancies are concerning since research has shown that learning is enhanced when there are matches between student and teacher demographics. Steps are being taken to address the discrepancies and this paper reports on the progress.

Moreover, efforts are being made to improve all teachers' awareness of how culture affects learning, including the role played by language and the learning of second languages. Pennsylvania is in the process of identifying competencies regarding cultural awareness and rubrics for assessing the degree to which teachers possess these competencies. Professional development is also being provided to assist teachers in their efforts to gain knowledge about and sensitivity to the impact of cultural on learning. The following nine competencies have been identified and are in the process of being field tested:

Competency 1: Reflect on One's Cultural Lens

Competency 2: Identify, Deepen Understanding of, and Take Steps to Address Bias in the System

Competency 3: Design and Facilitate Culturally Relevant Learning that Bring Real World Experiences into Educational Spaces

Competency 4: Provide all Learners with Equitable and Differentiated Opportunities to Learn and Succeed

Competency 5: Promote Asset-based Perspectives about Differences

Competency 6: Collaborate with Families and Communities through Authentic Engagement Practices

Competency 7: Communicate in Linguistically and Culturally Responsive Ways that Demonstrate Respect for Learners, Educators, Educational Leaders, and Families

Competency 8: Establish High Expectations for Each Learner and Treat Them as Capable and Deserving of Achieving Success

Competency 9: Educate Oneself About Microaggressions, Their Impact on Diverse Learners, Educators, and Families and Actively Disrupt the Practice by Naming and Challenging its Use

This paper also reports on the development and implementation of these competencies.



## **Invited Talk # 7**

Supporting students digital learning of key STEM concepts: the  
Cornerstone Maths and ScratchMaths Approaches

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**Alison Clark-Wilson**

(UCL Institute of Education, University College London)

**Piers Saunders**

(UCL Institute of Education, University College London)

# **Supporting students digital learning of key STEM concepts: the Cornerstone Maths and ScratchMaths Approaches**

**Alison Clark-Wilson**

UCL Institute of Education, University College London

**Piers Saunders**

UCL Institute of Education, University College London

The use of digital resources to enable more dynamic approaches to the teaching of algebraic concepts has been the topic of extensive research in the learning sciences. In this talk Professor Alison Clark-Wilson and Dr Piers Saunders will report on two design-based research projects from the UK, Cornerstone maths and ScratchMaths, which offer exemplar student and teacher resources that seek to exploit student technology in transformative ways.

## **Symposium#1**

### Sport Science Research for Improving Health and Sport Performance

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#### **Tsung-Min Hung**

(Department of Physical Education and Sport Sciences, National Taiwan Normal University)

#### **Tzyy-Yuang Shiang**

(Department of Athletic Performance, National Taiwan Normal University, Taipei, Taiwan)

#### **Shao-Hsi Chang**

(Department of Physical Education and Sport Sciences, National Taiwan Normal University, Taipei, Taiwan)

#### **Wen-Bin Lin**

(Physical Education Center, Taipei National University of the Arts, Taiwan)

#### **Yu-Kai Chang**

(Department of Physical Education and Sport Sciences, National Taiwan Normal University, Taipei, Taiwan)

## **Sport science research for improving health and sport performance**

In this symposium presentation, five presenters will cover topics including exercise and cognitive health, use of technology for exercise promotion in the elderly individuals, development of measurement tools for biomechanical parameters, and use of data science for sport performance analysis. The wide range of topics presented here reflects the breadth and richness of research in sport sciences, while the practical application will be emphasized.

## Abstract 1

### Effects of exercise intensity and duration at a predetermined exercise volume on executive function among Apolipoprotein E (APOE)- $\epsilon$ 4 carriers

Yu-Kai Chang<sup>1,2</sup>, Costas I. Karageorghis<sup>3</sup>, Chun-Chin Wang<sup>4</sup>, Ruei-Hong Li<sup>1</sup>, Feng-Tzu Chen<sup>5</sup>, Ren-Yu Fang<sup>1</sup>, Tsung-Min Hung<sup>1,2</sup>

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<sup>2</sup> Institute for Research Excellence in Learning Science, National Taiwan Normal University, Taipei, Taiwan

<sup>3</sup> Department of Life Sciences, Brunel University London, Middlesex, UK

<sup>4</sup> Office of Physical Education, Soochow University, Taipei, Taiwan

<sup>5</sup> Department of Sports Medicine, China Medical University, Taichung, Taiwan

#### Abstract

The presentation is based upon Chang, Y. K. et. al (2022) in *Current Psychology*. Emerging evidence indicates that acute exercise improves executive function, but its effects on higher-order executive functioning skills among people with a risk of Alzheimer's disease are not well understood. This study addressed the effects of acute exercise on the planning dimension of executive function among late middle-age adults who carried Apolipoprotein (APOE)- $\epsilon$ 4. Exercise volume was kept constant, but exercise intensity and duration were manipulated. Eighteen adults in the age range 55–70 years who carried APOE- $\epsilon$ 4 were recruited for a laboratory-based study set in a within-subjects, counterbalanced design. There was a reading control condition along with three exercise conditions: Acute cycle exercise at a moderate intensity for 30 min (MI-30); higher intensity exercise of a shorter duration (16 min); and lower intensity exercise of a longer duration (40 min). Exercise volume was set with reference to energy expenditure in MI-30. The Tower of London Test was administered at the end of each condition. Acute aerobic exercise improved cognitive performance in regard to move-related scores and time-related scores, but not violation-related scores, when compared to the control condition. There was no difference in terms of the facilitation effect among the three exercise conditions. The present findings indicate that acute aerobic exercise, regardless of intensity/duration manipulation, facilitates higher-order executive function in late middle-aged APOE- $\epsilon$ 4 carriers. Practitioners should, accordingly, consider exercise as a suitable intervention for those at risk of Alzheimer's disease.

**Keywords:** Aerobic exercise, APOE genotype, Executive function, Exercise prescription, Planning

## **Abstract 2**

### **Cognitively engaging exercise may provide extra benefits for improving executive functions**

Tsung-Min Hung, Chiung-Ling Chu, & Ting-Yu Chueh

Department of Physical Education & Sport Sciences, National Taiwan Normal University, Taiwan

#### **Abstract**

Despite the benefits of exercise for improving cognitive function, executive functions in particular, have been studied extensively, the moderating effect of exercise parameters including mode, intensity, duration, and number of sessions in exercise prescription, were still inconclusive. Of these possible exercise moderators, mode of exercise represents the qualitative part of the exercise prescription consideration. Although aerobic and resistance exercise have received most attention in the past, coordinative exercise and other forms of cognitive engaging exercise, which may impose more cognitive demand on the exercisers, have become a new focus in this endeavor. This presentation intends to provide the theoretical background along with some supporting evidences for the extra benefits of cognitively engaging exercise for improving executive functions.

**Keywords:** Open skill and closed skill, adaptive capacity model, Cognitive Stimulation Hypothesis

## Abstract 3

# Validity of speed and acceleration for game sports derived from a new local positioning system

Philip X. Fuchs<sup>1,2</sup>, Yi-Cheng Chou<sup>1</sup>, Wei-Han Chen<sup>1,3</sup>, Tzyy-Yuang Shiang<sup>1</sup>

<sup>1</sup> National Taiwan Normal University, Taiwan; <sup>2</sup> University of Salzburg, Austria; <sup>3</sup> University of Taipei, Taiwan

Tracking player positions has increasingly become popular in game sports for tactical analyses and training load regulations. Although local positioning systems (LPS) were reported to be superior to GPS and video-based systems [1], data differentiated in the time-domain (i.e., speed and acceleration) were reviewed critically [2]. The objective was to assess the accuracy of a new LPS for speed and acceleration in dynamic movements, common to game sports.

Time-series and peak speed, acceleration, and deceleration were compared between concurrently collected data via LPS (50 Hz) and Vicon (100 Hz) data during 10 repetitions of linear, curved, triangle, and shuttle running in low and high intensity ( $n=80$ ). Data processing followed the developer guidelines, filtering after residual analyses, and synchronization via time-shift until the minimum error was reached [3]. Concordance correlation coefficients (CCC), percentage root mean square errors (RMSE), Bland-Altman plots, and analyses of variances were provided.

CCC were 0.893 (time-series speed), 0.816 (time-series acceleration), 0.923 (peak speed), 0.486 (peak acceleration), and 0.731 (peak deceleration). RMSE were larger in time-series acceleration ( $14.4\pm 3.8\%$ ) than speed ( $12.0\pm 5.8\%$ ) ( $\eta^2=0.472$ ,  $p<0.001$ ) and larger in peak acceleration ( $28.0\pm 14.3\%$ ) and deceleration ( $25.1\pm 14.9\%$ ) than in speed ( $7.3\pm 6.1\%$ ) ( $\eta^2=0.091$ ,  $p<0.01$ ). RMSE were also larger in high intensity compared with low intensity for time-series speed and acceleration as well as peak acceleration and deceleration ( $0.064\leq\eta^2\leq 0.475$ ,  $p<0.05$ ), but not significantly for peak speed ( $\eta^2=0.029$ ,  $p=0.149$ ). Bland-Altman plots including 95% limits of agreement and Spearman correlation results for trendlines were depicted in Figure 1.

Strong concordance and smaller errors in time-series speed and acceleration as well as peak speed suggested that the tested LPS can be used for applications when entire time-series data are required (e.g., for energy expenditure estimation via acceleration) [4] and when peak speed serves as a performance identifier (e.g., for determination of intensity zones) [5]. In consideration of previous studies [2], the current accuracy of both time-differentiated time-series was very promising. However, serious deficits were found in peak acceleration and deceleration, comparable with

previous findings [6]. The data suggested a lacking ability of the LPS to detect these peaks accurately with increasing magnitude of the true values. Acceleration data should be used with caution if peak values play a crucial role in the intended analyses (e.g., determining performance via peak values). Corroborated by others [7], this should be considered especially for very dynamic movements as errors increased in high intensity.

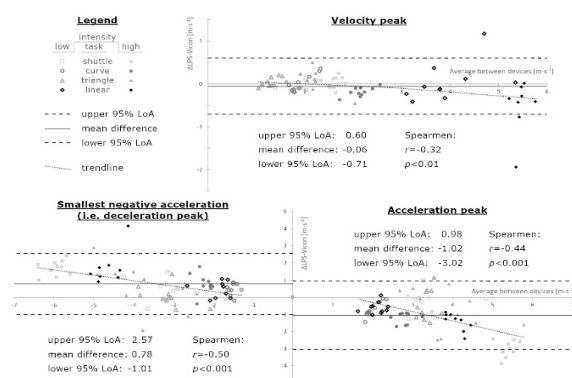


Figure 1: Bland-Altman plots of differences in peak speed, acceleration, and deceleration between LPS and Vicon including 95% limits of agreement (95% LoA) and Spearman correlation ( $r$ ) for trendlines; derived from [8].

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## **Abstract 4**

### **Research on the multi-component exercise intervention by IoT intelligence with holistic health of the urban- rural older adults**

Shao-Hsi Chang & Hung-Chin Huang

Department of Physical Education and Sport Sciences, National Taiwan Normal University, Taipei, Taiwan

#### **Abstract**

With the improvement of living standards and the advancement of medical technology, the proportion of Taiwan's older adults are rapidly increasing. In order to keep the quality of lives and dignity of the older adults, applying technology of Artificial Intelligence IoT (AIoT) has become an opportunity for effecting older daily life. There is great deal of general literature on smart-aging for improving life style of older adults, such as smart home, smart care, and smart security that have indeed changed people's lives. However, there is rarely evidence indicates that smart technology applies in promoting health outcome of older adults in Taiwan. The main purpose of this study is to examine the improvement of the whole-person health indicators of the elderly in urban and rural areas by the intervention of the multi-sport guided with smart internet of Things (IoT), and to realize the ideal of smart aging by the intervention mode of the multi-sport driven by the smart IoT technology. Quasi-experimental with pre- and post-intervention design (baseline and 12-week intervention) was used. Data were collected primarily by means of particular devices that the with smart IoT technology. Outcome measures included measures of functional fitness, quality of life questionnaire, Taiwan elderly simple depression scale and very early dementia screening scale. After 12-week intervention, the result showed significant improvement on functional fitness in each group (control group and intervention group) after 12-week intervention. Furthermore, the urban-rural disparities will be further analyzed.

**Keywords:** elderly population, intelligent health promotion, Internet of Things, pluralistic movement, whole-person health indicators.



## Abstract 5

### **Smarter, not harder: applied data science for technical and tactical analysis in sport**

Mei-Yen Chen<sup>1</sup> & Wen-Bin Lin<sup>2</sup>

<sup>1</sup>Graduate Institute of Sport, Leisure and Hospitality Management, National Taiwan Normal University, Taiwan

<sup>2</sup>Physical Education Office, Taipei National University of the Arts, Taiwan

#### **Abstract**

Sports analytics is the practice of applying mathematical and statistical principles to sports and related peripheral activities. While there are many factors and priorities specific to the industry, sports analysts use the same basic methods and approach as any other kind of data analyst. Sport data science can combine the perspectives of psychology, physiology, and medicine along with rehabilitation and sports performance. This unique combination gives an insight as to how the human body works before, during and after exercise. We introduced concepts of sport big data and data science in the development of Taiwanese baseball and constructed and analyzed the results "team defense," "team offense," "player defense," and "player offense" for the intelligence-gathering system of teams in the Chinese Professional Baseball League. The testing results were ideal for reaching a long-term tracking target to take into academic research and practical application and verify the importance and feasibility of this study. We also constructed the intelligence gathering system and tracking intelligence-gathering trends, and carrying out the big sports data belongs to Taiwanese baseball professional development, values, and intelligence gathering. Analytics is a rapidly evolving technology that involves the use of data and statistical analysis to make well-thought and researched decisions.

**Keywords:** sport big data, frontier analytics, elite sport

## **Symposium#2**

### The Road not Taken: IRELS at NTNU

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**Chin-Chung Tsai**

(National Chair Professor, Dean, School of Learning Informatics, National Taiwan Normal University, Taiwan)

**Fang-Ying Yang**

(Graduate Institute of Science Education, National Taiwan Normal University, Taiwan)

**Hsien-Sheng Hsiao**

(Department of Technology Application and Human Resource Development, National Taiwan Normal University, Taiwan)

**Po-Hsi Chen**

(Department of Education Psychology and Counseling, National Taiwan Normal University)

**Yi-Fang Hsu**

(Department of Education Psychology and Counseling, National Taiwan Normal University)

**Chun-Yen Chang**

(Chair Professor and Director of the Science Education Center, National Taiwan Normal University, Taiwan)

## **The Road not Taken: IRELS at NTNU**

Collaborating in interdisciplinary research could be deemed an unusual path in academic life. IRELS (Institute of Research Excellence in Learning Science) at NTNU convenes a group of researchers in cognitive psychology, computer science/engineering, educational science, e-Learning, and STEM education for collaborative research across disciplines. This symposium highlights past efforts and envisions future adventures.

## **Abstract 1**

### **Brain Activations During Problem Solving Before and After the Concept Learning of Moon Phases**

Fang-Ying Yang

Graduate Institute of Science Education, National Taiwan Normal University

How the brain may be activated during a learning task has interested many educational researchers. However, although there are neuro tools such, as EEG, MRI and MEG, that can be used to record signals from brain activities, the research about brain activation during science learning-related tasks is difficult and consequently under development. In the study, we made an attempt to explore brain activations during problem solving before and after a learning task using Magnetoencephalography (MEG). In addition to our interest in understanding the cognitive mechanism of problem solving, we hope to start a new line of research that can provide neuro perspectives about science learning.

MEG is a neuroscience tool measuring the magnetic fields produced by brain's electrical currents, i.e., the brain waves. It is performed to map brain function and to identify the exact location of brain activation. We are chiefly interested in two types of brain signals: the alpha and beta waves. The former is said to relate significantly to attention and working memory (Başar & Güntekin, 2012; Wutz et al., 2020) while the later more to thinking and information processing (Gelastopoulos et al., 2019; Seleznov et al., 2019). For the study, we created a computerized interactive learning program on the topic of Moon phases which involves complex concepts such as the spatial relations among sun, earth and the moon, the revolution and rotation of the earth and the moon. Two tests with different items but under the same concepts were then developed as pre- and post-test for the MEG analysis.

Preliminarily, the study found that when learners answered different types of questions, the brain activations and connections of the brain regions in learners were different. This phenomenon was particularly apparent for test items that required complex spatial thinking. More interestingly, we found that most of students who succeeded in the post test showed a tendency of reduction in their brain activations when solving simple items but the activations became stronger when solving the complex ones. Meanwhile, the connections of brain regions became weaker in the post-test. The result is overall theoretically sound.

Studying students' brain activation duration problem solving using MEG is complicated and time consuming. The work involves not only the learning and operation of the neuro equipment but also the analysis and decipher of the brain

signals. A collaboration of experts in different fields including science education, psychology, and informatics is crucial. The MEG provides great time resolution that can show the process of problem solving but currently our study has not taken advantage of the feature. There are more works to be done in the future.

## **Abstract 2**

### **Using gesture interactive game-based learning approach to improve preschool children's learning performance and motor skills**

**Hsien-Sheng Hsiao**

Department of Technology Application and Human Resource Development,  
National Taiwan Normal University, Taiwan

Children love to play games, and early childhood is a critical time for developing motor skills. We combined gesture-based computing technology and a game-based learning model to develop a gesture interactive game-based learning (GIGL) approach for preschool children. The GIGL approach demonstrated better learning performance and motor skills than those who used the traditional activity game-based learning approach.

We evaluated the effectiveness of a interactive game-based learning approach using a somatosensory device on preschoolers. The learning performance (i.e. knowledge of plant growth) and motor skills (i.e. body coordination and movement agility) of the participants were also evaluated. Moreover, we aimed to examine the learning and motion behaviors of the students who used the gesture-based learning approach.

We developed an interactive game-based learning approach to build a virtual interactive learning environment for preschoolers by combining a gesture-based computing device and a game-based learning model. Using sequential analysis, this study investigated how this approach influenced children's learning performance, motor skills, and motion behaviors. A quasi-experiment was conducted with 142 kindergarten-level-3 preschoolers. The results showed that the gesture-based learning approach improved the students' learning performance and motor skills compared with the traditional activity game-based learning approach. The main learning pattern showed that the preschoolers controlled their body motion behaviors and movements

to learning cognitive knowledge, which achieving a flow state that improved preschoolers' learning performance and motor skills. In addition, the main motion pattern showed that the preschoolers interacted with the game by coordinating their body movement with the projected human skeleton's movement, which improved their motor skill.

This study showed the effectiveness of the gesture-based learning approach, and it also found learning and motion behavior patterns from the results of the gesture-based learning game. The preschoolers' learning performance, body coordination, and movement agility were improved after playing the gesture-based learning game. This implies that the gesture-based learning approach supported the connection between the students' mind and body and reinforced their internal cognitive knowledge and external motor skills to help them learn. From this research experience, the promotion strategy for gesture-based learning should be to (1) plan a gesture-based learning class using a gesture-based device that the students can take turns using; and (2) train teachers and students to use the gesture-based learning approach, learning platform, gesture operation tool, and body posture operation tool.

### **Abstract 3**

#### **Intelligent Assessment: Integration of Psychometric Model and New Technology**

Po-Hsi Chen, Yao-Ting Sung, Chia-En Hsieh, Yeh-Tai Chou  
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Smart technology had been developed for decade and made great impact on our daily life. Psychological tests are also influenced by new technology not only in model construction but also in test execution. The new development in both maximum performance test and typical performance test had been suggested in our project. In maximum performance test, we applied article intelligence on test item generation, test execution and test scoring of constructive response items. The auto item generation system (AIGS) had been developed and got patent in Taiwan. Natural language processing and item shells based on the Bloom's taxonomy had been used in developing the algorism. It can generate selective response items and constructive response items for science test and reading test. Items for assessing different types of cognitive process, such as explain, inference, classifier, example, or conceptual and procedural knowledge, can be generated in our platform. In typical performance test,

a comprehensive testing method, the Visual Analogue Scale for Rating, Ranking, and Paired-Comparison (VAS-RRP; Sung & Wu, 2018), had been developed. The VAS-RRP can be used to collect rating, ranking, and paired-comparison data and continuous VAS data simultaneously. It provides appropriate accuracy, reliability, and responsiveness and overcoming the limitations of response styles to Likert-type scales. We have developed a website called VAS-RRP 2.0 ([www.vasrrp.net](http://www.vasrrp.net)) for researchers to construct, administrate and analyze their own VAS-RRPs. The aforementioned research outcomes supported that VAS-RRP is helpful for obtaining more precise, reliable and valid measurements in psychological assessment.

Keywords: artificial intelligence, automatic item generation, maximum performance test, visual analogue scale, rating scale, ranking scale

#### **Abstract 4**

### **Applying cognitive neuroscience techniques to explore and practice interdisciplinary learning theory**

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This is a progress report on the project in educational neuroscience funded by Taiwan Ministry of Education. We used electroencephalography (EEG), functional magnetic resonance imaging (fMRI), and eye-tracking to investigate the neural basis of working memory (including executive function) in learning. I will present the result of an EEG experiment as an example, where we found that alpha activity, subject to interindividual differences in sensitivity, could serve as a brain-based measure of an individual's working memory functioning.