NATIONAL TAIWAN NORMAL UNIVERSITY

Featured Research Newsletter

ISSUE 05 / Summer 2024

Institute for Research Excellence in Learning Sciences Leads Effort for Digital Teaching and Teacher Education

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學習科學跨國頂尖研究中心

Institute for Research Excellence in Learning Sciences

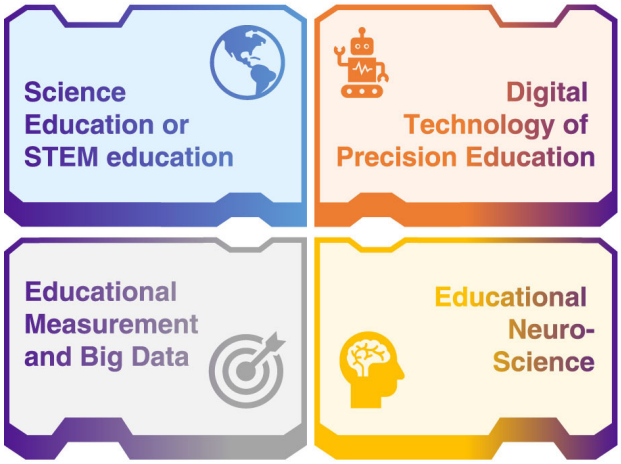
IRELS INTRODUCTION

Institute for Research Excellence in Learning Sciences Leads Effort for Digital Teaching and Teacher Education

In 2013, National Taiwan Normal University (NTNU), with the support of the National Science Council and in collaboration with Pennsylvania State University, established the Institute for Research Excellence in Learning Sciences (IRELS). The primary goal of IRELS is to become a leading institute in education research, setting a global standard for teacher education and fostering sustainable development within the education sector. To achieve this goal, IRELS aligns with international trends in educational research, national policies, and societal demands. By embracing the principles of openness, sharing, collective knowledge, and sustainability (OSaCKS), IRELS addresses educational challenges both in Taiwan and globally. The first director of IRELS, Dr. Chin-Chung Tsai, played a pivotal role in establishing the institute's vision and foundational principles.

Research Focus

Leveraging the university's interdisciplinary expertise in psychology, education, computer science, information engineering, and special education, IRELS has outlined four main tracks to make substantial contributions nationally and internationally to the field of learning sciences. The four main tracks are as follows:



Academic Performance

Publications in SSCI Journals Indexed in Web of Science from 2018 to 2023*

WEB OF SCIENCE

434
Total Number of Journal Articles Published in SSCI Journals

5100
Citiation Count

11.75
Citations per Publication

35
Hi-index

199 (45.6%)
International Collaboration

Publications in Scopus-Indexed Journals from 2018 to 2023*

Scopus

510
Total Number of Journal Articles Indexedin Scopus

2.00
FWCI

220 (43.1%)
International Collaboration

364 (72.4%)
Publications in Q1 Journals

230 (45.7%)
Publications in the Top 10% Journal by CiteScore

*(*based on the search conducted on April 8, 2024)*

World's Top 2% Scientists

On October 4, 2023, eight IRELS researchers from National Taiwan Normal University were listed on the Lifetime Scientific Impact list of the World's Top 2% Scientists, and nine were listed on the Annual Scientific Impact list. These achievements underscore the international recognition and significant impact of their research. Related Links: World's Top 2% Scientists 2022, https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw/6.

List of Career-Long Impact (1960-2022)	List of Single Year Impact (2022)
Prof. Tsai Chin-Chung	Prof. Tsai Chin-Chung
Prof. Chang Chun-Yen	Prof. Chen Nian-Shing
Prof. Chang Yu-Kai	Prof. Hong, Jon Chao
Prof. Chen Nian-Shing	Prof. Chang Yu-Kai
Prof. Tsai Meng-Jung	Prof. Tsai Meng-Jung
Prof. Liu Tzu-Chien	Prof. Sung Yao-Ting
Prof. Tseng Yuen-Hsien	Prof. Liang Jyh-Chong
Prof. Sung Yao-Ting	Prof. Chang Chun-Yen
	Prof. Chang Hsin-Yi

COVER STORY

Dr. Chun-Yen Chang - Director of IRELS and His Groundbreaking Research in Science Education

Dr. Chun-Yen Chang is a science education scholar in Taiwan. Currently, he serves as National Taiwan Normal University (NTNU) Chair Professor, Director of the Science Education Center (NTNU), and Professor of the Graduate Institute of Science Education and the Department of Earth Sciences (NTNU). From July 2022, he also serves as the Adjunct Professor of the Department of Biology, State University of Malang, Indonesia. Over the past few years, he has been a Visiting Professor at the Taipei Medical University, The Education University of Hong Kong, and the Paris 8 University. Dr. Chang's major research interests include science education, e-Learning, interdisciplinary science learning, and science communication.

Dr. Chang has authored and co-authored more than 150 articles, from which more than 130 are indexed in the Science/Social Science Citation Index (SCI/SSCI) database. Countries such as the United States, United Kingdom, France, Germany, Sweden, Slovenia, Italy, Bulgaria, Montenegro, China, Japan, Korea, Singapore, Hong Kong, Inner Mongolia, Turkey, the Philippines, Thailand, Vietnam, Oman, and India, continue to invite Dr. Chang as a keynote/ feature speaker.

Dr. Chang is currently the Editor-in-Chief of four journals: (1) Eurasia Journal of Mathematics, Science and Technology Education; (2) European Journal of Mathematics and Science Education; (3) Educational Innovations and Emerging Technologies, (4) Applied System Innovation (Section Editor-in-Chief), as well as on the Editorial Board of three SSCI-level journals: (1) Studies in Science Education (science education); (2) Learning, Media & Technology (learning technology); (3) Journal of Science Education and Technology (science education & technology).

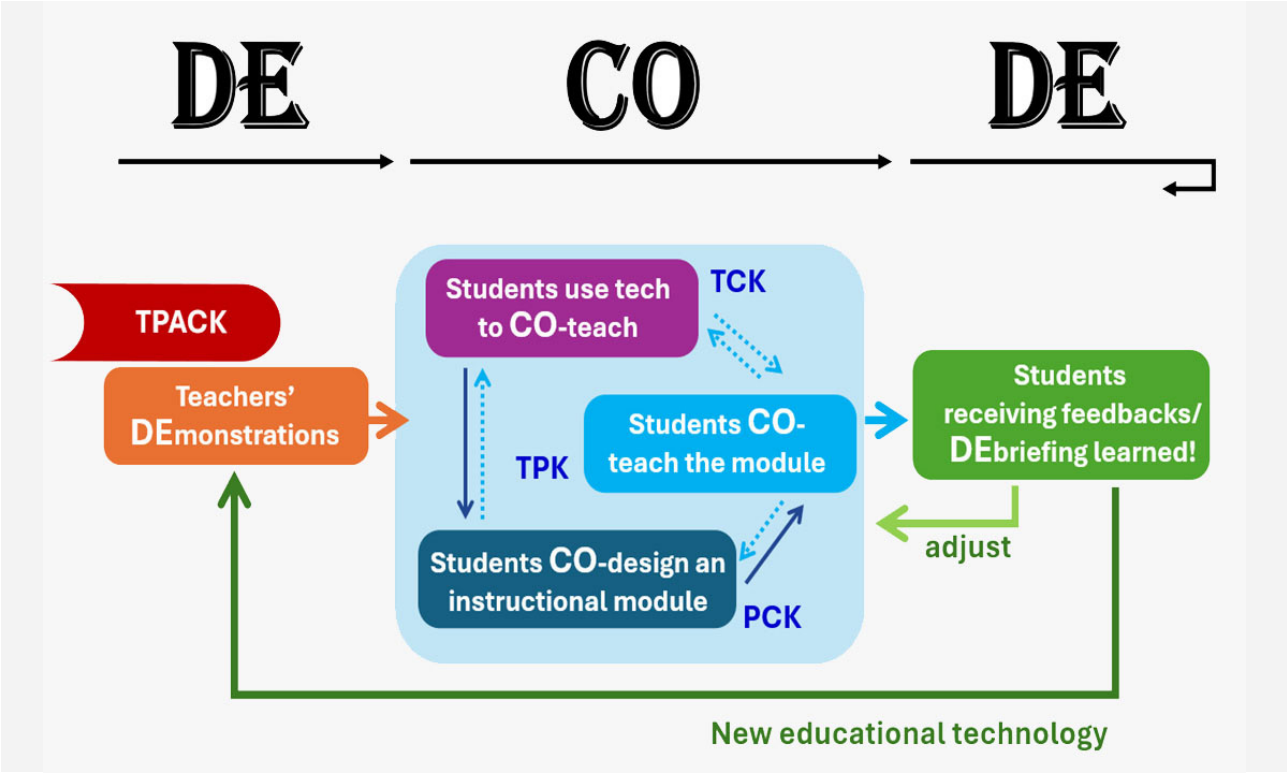
In 2008 NSTC's 50th anniversary celebrations, Dr. Chang's research work on problem-solving ability and automatic scoring of science open-ended questions was honored as one of the NSTC's 50 Great Achievements. In 2003, 2009, and 2012, Dr. Chang was granted three times one of the highest honors given by NSTC: the "Outstanding Research Award." In February 2013, Dr. Chang's catechol-O-methyltransferase (COMT) study was privileged in a New York Times Sunday Magazine report and in the news featured on the Association of Psychological Science website. In 2019, the CouldClassRoom (CCR) mobile system, developed by Dr. Chang and his research team, was selected as an exemplary institution in the 2019 EDUCAUSE Horizon Report.

Want to know more:

1. *New York Times Sunday Magazine report on catechol-O-methyltransferase (COMT) study*
2. *EDUCAUSE Horizon Report on CloudClassRoom (CCR) mobile system*

DECODE for Digital Teaching and Teacher Education

In this era, the young generation are the digital natives. They are well-versed in technological knowledge, which encompasses the familiarity with using various technological tools. However, effective teaching with technology is a skill that needs to be cultivated and nurtured. Professor Chang formulated the DECODE model, which emphasizes collaborative efforts in the design, development, and execution of instructional modules enriched with technology (Cheng et al., 2022). The



DECODE model

DECODE model aims to facilitate participants' learning about technology utilization while concurrently developing their understanding of how to effectively teach using technological tools. DECODE comprises three distinct stages: (1) DE: Teacher's Demonstration - Trainers showcase exemplary utilization of educational technology tools; (2) CO: Participants Co-Train - Participants collaborate in practicing technology integration and designing technology-enriched classroom activities; (3) DE: Participants Debrief - Participants engage in teaching with educational technology, receiving peer feedback, and summarizing their learning experiences.

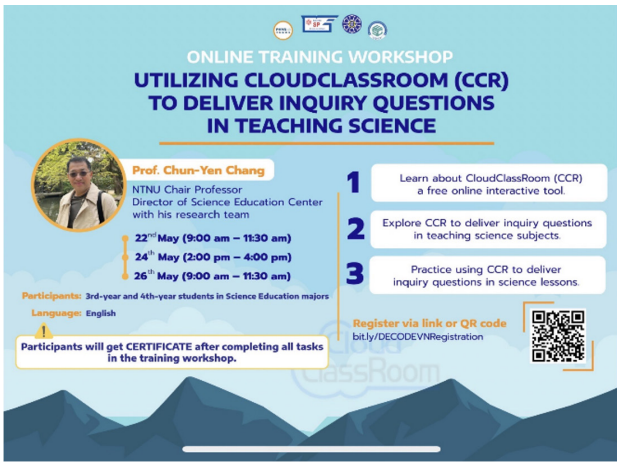
Professor Chang led his research team to employ this model promoting CloudClassRoom (CCR) incorporation into instruction. For instance, Initially, the focus is on improving teachers' technological knowledge (TK) about CCR through educator-led demonstrations that illustrate the questioning function of ICT. Following this, the training shifts to hands-on activities where students co-train in the use of CCR, working in small groups to both teach and learn, thereby enhancing their technological content knowledge (TCK). As the program progresses, the students are tasked with co-designing an CCR-integrated course, aiming to bolster their pedagogical content knowledge (PCK) in their specific teaching disciplines. This involves each group developing a concept map, teaching content, and questions that incorporate CCR use. The culmination of the training involves the students co-teaching their designed courses to their peers. This not only allows them to apply CCR practically but also improves their technological pedagogical content knowledge (TPACK) through peer feedback on their teaching methods and course designs.

DECODE-CloudClassRoom in Taiwan

An Adaptive Model for Diverse Scenarios

In the initial DE stage, instructors introduce innovative educational technologies and demonstrate how these technologies can be integrated into teaching and learning processes; therefore, teacher educators have the flexibility to determine the specific technological tools and instructional methods to be covered. In other words, the DECODE model is adaptable and applicable to diverse educational contexts and scenarios. In Taiwan, Professor Chang has effectively utilized the DECODE model to equip teachers with the skills necessary for promoting self-regulated learning among students, aligning with both global trends and domestic policies (Sui et al., 2024b). Building on this success, Professor Chang has led the expansion of the

Training pre-service teachers globally with DECODE model

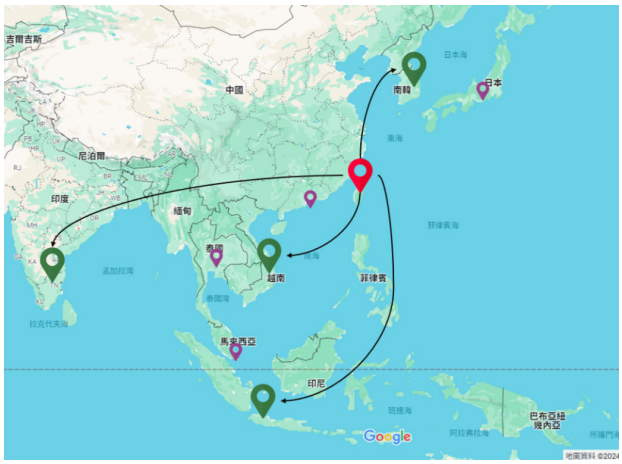


Training pre-service teachers globally with DECODE model

DECODE model throughout Asia, including in Singapore, Japan, South Korea, Hong Kong, Indonesia, India, Vietnam, and Thailand. In particular, educational institutions in India and Indonesia have tailored the model to focus on STEM education (Rajasekaran et al., 2024; Wahono et al., 2022). In South Korea, Ga and Chang (2024, January) applied DECODE to train teachers in using Internet of Things (IoT)-based learning methods. Additionally, Universitas Pendidikan Indonesia and Ho Chi Minh City University of Education in Vietnam have collaborated with our team to implement DECODE in training pre-service teachers in various scenarios, including STEM and inquiry-based learning.

DECODER, an Extension Model, and its Future

Professor Chang has proposed an extension to the DECODE model, termed DECODE+R, where “R” stands for “Real implementation.” This new stage is designed to bridge the gap between theoretical training



Promoting map in Asia

and practical application in actual classroom settings. The “R” stage aims to refine educators’ understanding and enhance their competency in integrating technology into their teaching practices. It encourages educators not only to use technology but also to adapt their pedagogical approaches based on the dynamics and feedback of real-world classrooms. For example, Sui et al. (2024a) explored how two in-service teachers, trained in DECODE-SRL workshops, implemented technology-enhanced SRL strategies in their classes. The results showed that students found these structured and informative strategies highly effective in enhancing their self-regulation, which in turn helped teachers evaluate the impact of their methods and allowed teacher educators to refine and optimize their training programs. Building on this, our team is developing the DECODER model, a more comprehensive framework that not only provides educators with technological skills but also supports them in the effective implementation of these technologies within their educational settings. This ensures a pragmatic and impactful learning experience for both educators and students.

Cheng, P.-H., Molina, J., Lin, M.-C., Liu, H.-H., & Chang, C.-Y. (2022). A New TPACK Training Model for Tackling the Ongoing Challenges of COVID-19. Applied System Innovation, 5(2), 32. https://doi.org/10.3390/asi5020032

Ga, S., & Chang, C.-Y. (2024, January). Empowering Environmental Science Agency in Students through IoT-Enabled Action-Oriented Education Asian Symposium on STEM Education, Tainan, Taiwan.

Rajasekaran, R., Sreedevi, P. S., & Chang, C.-Y. (2024). DECODE-based STEM workshop in improving academic resilience and teaching competency of pre-service teachers. EURASIA Journal of Mathematics, Science and Technology Education, 20(2). https://doi.org/10.29333/ejmste/14243

Sui, C.-J., Yen, M.-H., & Chang, C.-Y. (2024a). Investigating effects of perceived technology-enhanced environment on self-regulated learning. Education and Information Technologies, 29, 161-183. https://doi.org/10.1007/s10639-023-12270-x

Sui, C.-J., Yen, M.-H., & Chang, C.-Y. (2024b). Teachers’ perceptions of teaching science with technology-enhanced self-regulated learning strategies through the DECODE model. Education and Information Technologies. https://doi.org/10.1007/s10639-024-12715-x

Wahono, B., Hariyadi, S., & Subiantoro, A. W. (2022). The development of an online STEM teacher professional development package with the DECODE model: An innovative teacher’s quality maintenance. EURASIA Journal of Mathematics, Science and Technology Education, 18(12). https://doi.org/10.29333/ejmste/12647

ADDITIONAL NEWS AND HIGHLIGHTS

Research News

(VAS-RRP) Visual Analogue Scale for Rating, Ranking and Paired-Comparison : A New Technique for Psychological Measurement

Dr. Yao-Ting Sung is a Chair Professor of the Department of Educational Psychology and Counseling at the National Taiwan Normal University (NTNU), and has successively served as the Vice President of the NTNU, and the director of the “Higher Education Sprout Project Office”.

Professor Sung was awarded the Outstanding Research Award of the National Science and Technology Council (2006, 2010, and 2015) and the Academic Award of MOE (2020), which affirmed his educational contribution.

Professor Sung ‘s research interests include educational psychology, educational and psychological testing, competence-oriented learning for Chinese as a foreign language, computational psychometrics and other interdisciplinary topics.

In the field of educational and psychological testing, Likert-type scales are one of the most popular rating scales used in surveys to measure respondents’ traits. However, Likert-type scales have some inherent disadvantages, such as response styles, the fact that they produce ordinal measurement data, and ambiguous numbers of response categories. For those who do not wish to ignore the problems inherent to Likert-type scales, Professor Sung proposed a new technique for psychological measurement,

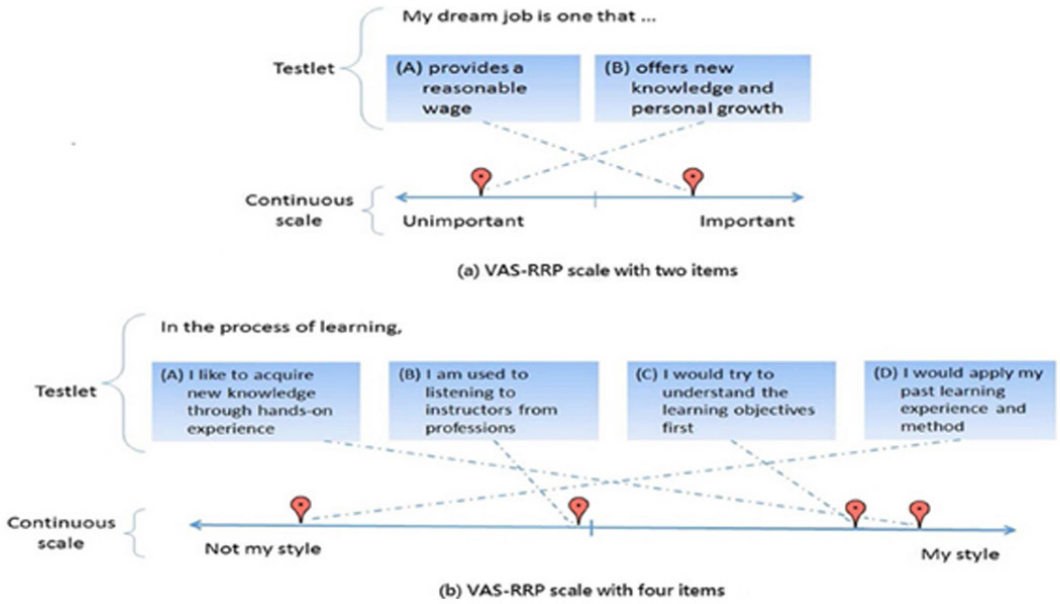
called the Visual Analogue Scale for Rating, Ranking and Paired-Comparison (VAS-RRP), which can be used to collect rating, ranking, and paired-comparison data simultaneously, while avoiding the aforementioned limitations.

Visual Analogue Scale for Rating, Ranking and Paired-Comparison (VAS-RRP)

Components of the VAS-RRPs and their usage

VAS-RRPs consist of two components (as shown in Figure 1): The first is a testlet, composed of one or more items, which may be of one or several semantic types—such as adjectives, nouns, phrases, and sentences—for eliciting participants' internal responses, including attitudes, opinions, interests, and so forth. The second component is a continuous rating scale, which is a line continuum with a midpoint and two directional arrows referring to two increasingly opposite levels of semantics; for example, indications made toward the right of the continuum reflect a respondent with a higher level of preference for certain objects, whereas those made toward the left reflect increasing aversion.

Figure 1a is a testlet with two items. The respondent compares the two items on the basis of their perceived importance, and then indicates the items on the continuum. In addition, the midpoint of the continuum helps the respondent differentiate whether or not an item is considered important. In Fig. 1a, the respondent indicated that one item is important and the other is not. Figure 1b is a testlet that has four items (A, B, C, and D) representing four different styles of learning. The respondent has rated how similar each of the learning styles is to his or her own personal learning. The respondent lists the styles as A, C, B, and D, in order of decreasing similarity with his/her

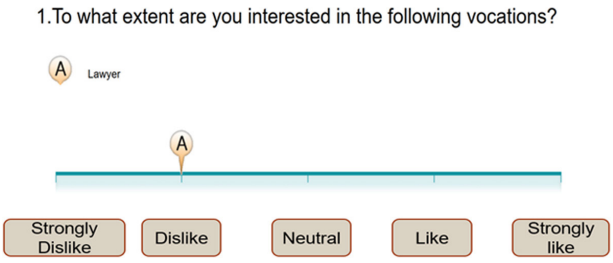


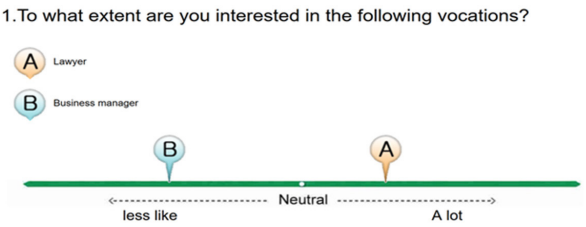
Features of the VAS-RRP

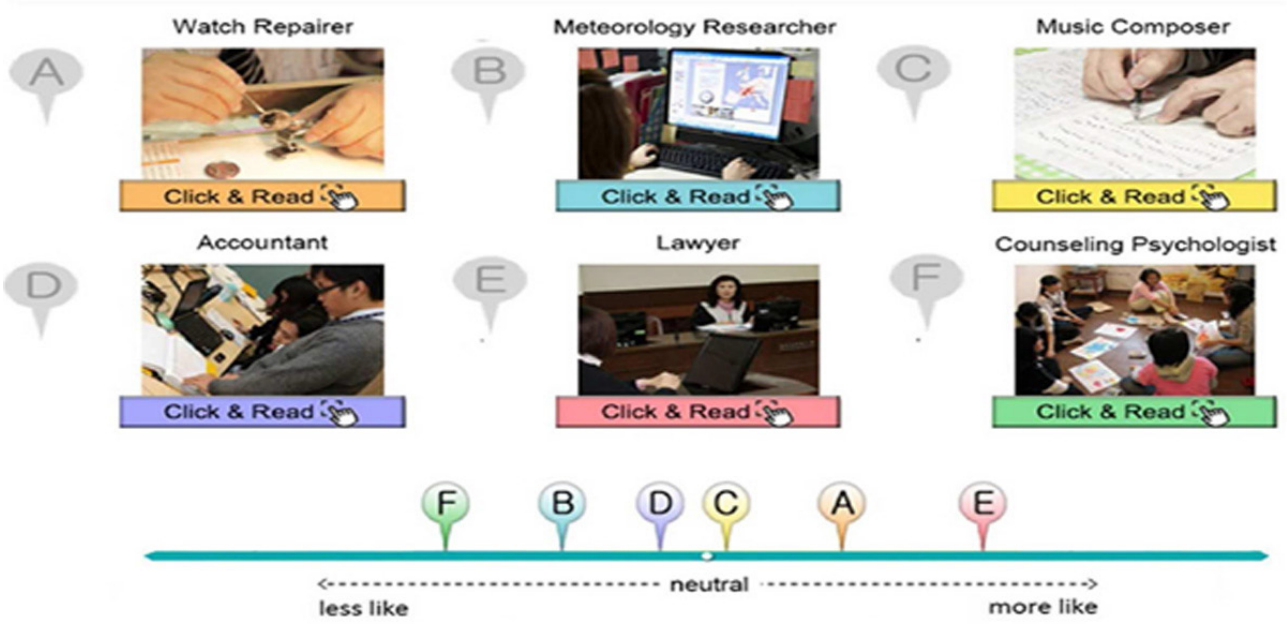
own ways of learning. The figure shows that the respondent considers A and C to be quite similar to his/her learning style, whereas B and D are not. The figure also shows that the respondent considers the difference between A and C to be slight, and the differences between B and C and between B and D to be larger.

As compared to Likert-type scales, ranking, paired-comparison methods, and VASs, VAS-RRPs have distinct features, as follows:

1. The VAS-RRP can elicit respondents' fine-grained responses on a line continuum.
2. While using a VAS-RRP, if there are multiple items in a testlet, respondents can implement comparative judgments for the items in each testlet.
3. Other types of scales can be viewed as special cases of the VAS-RRP. For example, if the VAS-RRP has only one item in each testlet, the VAS-RRP can be used as a VAS; this format of VAS-RRP can also be used as a Likert-type scale by assigning categories (e.g., five or seven terms for describing the intensity, as shown in Figure 2) to the line continuum for responses and calculating the scores. For the format of a VAS-RRP with two or more items, the VAS-RRP can function as a ranking or paired-comparison task (as shown in Figure 3 and 4), because the ordering positions of all those items on the line continuum reveal information about ranks, and the relative positions of each item reveal information about paired comparisons.







ADDITIONAL NEWS AND HIGHLIGHTS

Research News

Virtual Reality as a Tool for Investigating Instructional Design Principles in Real Classroom

The application of instructional design principles in real classroom situations has long been a topic of significant interest among researchers. Investigating these principles within classrooms is challenging due to the complexities of manipulating variables and controlling for interfering factors. To address this issue, Prof. Liu Tzu-Chien and his team turned to virtual reality (VR) technology. They simulated classroom environments and conducted a series of studies to investigate instructional design principles in real classroom based on cognitive load theory (CLT) (Sweller, 2020), including the redundancy effect and the effects of arrow-line cues (Liu et al., 2015, 2019, 2021). The VR classroom includes essential elements of a real classroom, allowing participants to immerse themselves in a lifelike educational environment. Meanwhile, researchers can systematically manipulate and control specific variables.

The results of these studies demonstrated the effectiveness of the VR classroom as a research platform for exploring various instructional design principles within authentic classroom contexts. This series of studies also illustrates the potential of VR-based research platforms to address the longstanding dilemma in social science research of balancing internal and external validity. The flexibility and scalability of this virtual classroom research platform make it suitable for validating various learning and teaching issues that occur in classroom situations.

Figure Screenshots showing the learning environment of VR classroom used to examine the redundancy effect (Liu et al., 2021)

ADDITIONAL NEWS AND HIGHLIGHTS

Engagement News

NTNU's new Earthquake Response IVR system, in partnership with Education department of New Taipei City Government, aims to enhance students' escaping response

National Taiwan Normal University (NTNU) has developed an Immersive Virtual Reality (IVR) system aimed at improving earthquake preparedness among students. The system, named the 'Earthquake escaping response IVR system,' has been promoted in cooperation with the Education Department of the New Taipei City Government. On May 14th, Dr. Chang Ming-Wen, Director of the New Taipei City Education Department, Professor Sung Yao-Ting, Vice President of NTNU, and Professor Hong Jon-Chao attended the official launch ceremony. At the launch ceremony, students from BeiDa Elementary School and

Dingpu Elementary School used the IVR system to conduct an earthquake simulation practice, demonstrating their evacuation response skills.

This initiative is particularly significant in Taiwan, a region prone to natural disasters such as earthquakes. The IVR system incorporates psychological principles such as scaffolding learning, personalized learning, and interactive feedback to teach students how to respond effectively during such emergencies. Developed under the Ministry of Education's "Higher Education Sprout Project," the system was created by a team led by Prof. Hong Jon-Chao at NTNU's Institute for Research Excellence in Learning Sciences. The system has patent certifications in both Taiwan (I721899) and the United States (US011443653B2). It is designed for scaffolding learning, offering training and situational simulation modes to achieve a personalized learning experience.

The collaboration aims to enhance students' disaster prevention literacy and practical response skills. Dr. Chang Ming-Wen, Director of the New Taipei City Education Department, emphasized the partnership's role in fostering disaster preparedness and safety awareness among students, aligning with the United Nations' Sustainable Development Goals. The system's implementation in schools also supports flipped learning, combining traditional education with disaster prevention technology. The initiative not only equips students with vital skills but also strengthens the connection between local governments, schools, and academic institutions in disaster preparedness efforts. (Institute for Research Excellence in Learning Sciences)

ADDITIONAL NEWS AND HIGHLIGHTS

Upcoming Events

International Workshop on Advanced Learning Sciences - IWALS 2024

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 fields 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, Taiwan, and Malaysia. This year, it will be held physically in Vietnam.

On behalf of the Organising Committee, we are pleased to invite you to the 10th International Workshop on Advanced Learning Sciences which will be held physically in Vietnam. The 2024 IWALS will be held from December 14 to December 15. Please keep this event in your diary. The workshop includes the Keynote Speech, Invited Symposium, Invited Talk, Paper presentations, and Poster Presentations.

Topics of interest for submission include, but are not limited to:

- Learning Science: Conceptual Understanding (Including theories, models, and empirical results on conceptual understanding, conceptual change approaches to learning in science, methodology for investigating students' processes of concept formation and concept use, and strategies to promote conceptual development)
- Science Teaching Processes and Instructional Design

- Digital Resources for Science Teaching and Learning
- Nature of Science: History, Philosophy and Sociology of Science
- Discourse and Argumentation in Science Education
- STEM/STEAM Education from preschool to high schools
- Equity, Diversity and Identity in Science Education
- Evaluation and Assessment in Science Teaching and Learning
- Teaching and Learning Science at the K-12 education and University.
- Pre-service and In-service Science Teachers Education
- Cognitive neuroscience of language development, language impairment, reading development, and reading impairment

Important Dates

- Abstract submission deadline: 15 September 2024
- Acceptance Notification: 5 October 2024
- Early-bird payment/ Registration Deadline: 15 September 2024
- Later payment/ Registration Deadline: 25 October 2024

Organizers

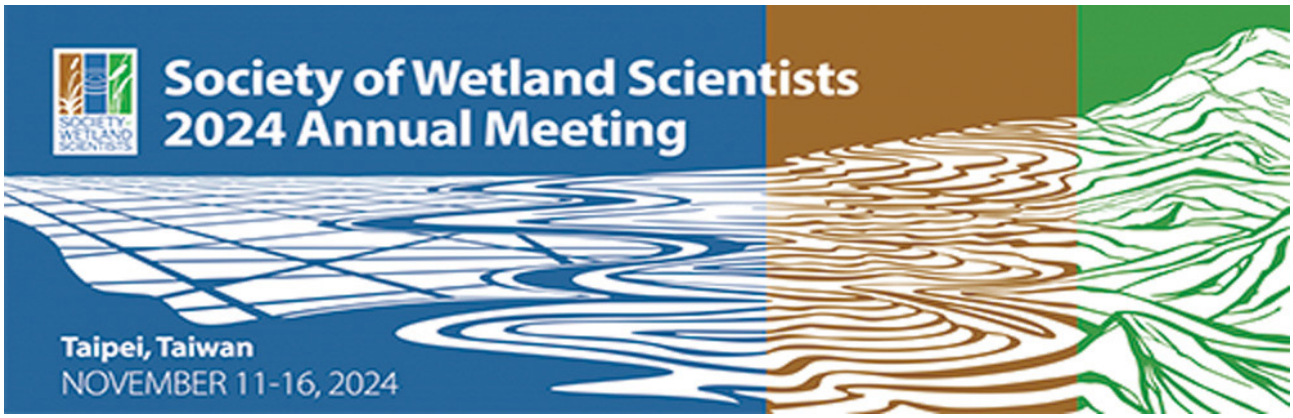
- Hanoi National University of Education
- National Taiwan Normal University

For more information, visit the event page.

ADDITIONAL NEWS AND HIGHLIGHTS

Upcoming Events

Nature Taiwan - Wild Wetland 2024



Taiwan will be the host to organize the 2024 Society of Wetland Scientists (SWS) 2024 Annual Meeting, which will be co-hosted by the SWS Asia Chapter, National Taiwan Normal University, and the Taiwan Wetland Society. This SWS 2024 Annual Meeting will collaborate with our partners at Taipei International Convention Center (TICC) from November 12 to November 14 , 2024. This conference, the first SWS Annual Meeting to be held in Asia, will take place in Taipei and Tainan, November 11 to November 16, 2024.

The SWS Asia Chapter, together with the Taiwan Wetland Society as well as National Taiwan University, have planned an exciting program around the theme, Wetlands and Climate Change: Mitigation and Adaptation. SWS 2024 will be an outstanding opportunity to hear from wetland researchers and professionals at the leading edge of blue carbon initiatives, net-zero emissions planning, sustainable resource use and development, community-led resilience planning, and wetland science more generally. This big event will be across the globe faced with more critical idea and challenge today than it has ever been, with increasing threats to wetlands associated with climate change, development, and changing water resource management practices. Therefore, this SWS Annual Meeting is an excellent opportunity to connect with wetland scientists and practitioners from around the worl d to share our research to inform management. The meeting will also feature amazing field trips to some of Taiwan's most spectacular wetlands. This meeting also represents an important step for the society in building stronger international ties, expanding participation, and broadening our relevance. I hope you will plan to join me for what promises to be an exciting and unique experience. It is my great pleasure to invite you to the Society of Wetland Scientists 2024 Annual Meeting in Taiwan. The meeting features a wonderful array of field excursions to some of Taiwan's most amazing wetlands – at a time of year when migratory waterbirds also congregate there! Call for abstract at https://sws2024.org/.

AWARDS & HONORS

Outstanding Research Award

Prof. Hsin-Yi Chang

Congratulations to Distinguished Professor Hsin-Yi Chang, Program of Learning Sciences, for receiving the 2024 Outstanding Research Award from the National Science and Technology Council, Taiwan.

Research Expertise :

> *Science Inquiry Learning Environments,*
> *Learning and Assessments Using Computer Simulations and Visualizations,*
> *Design-based Research*

Prof. Kai-Lin Yang

Congratulations to Professor Kai-Lin Yang, Department of Mathematics, for Receiving the Outstanding Research Award for 2024 from the National Science and Technology Council, Taiwan

Research Interests:

> *Teachers' knowledge and beliefs in statistics and geometry,*
> *Instruction and Assessment of Mathematical Modeling,*
> *Reading Perspectives on Learning Mathematical Proof*

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