

The Third International Conference for “Personal Epistemology and Learning in the Digital Age” Conference Program Book

*National Taiwan Normal University
Taipei, Taiwan, 28-30, November, 2019.*

Venues:

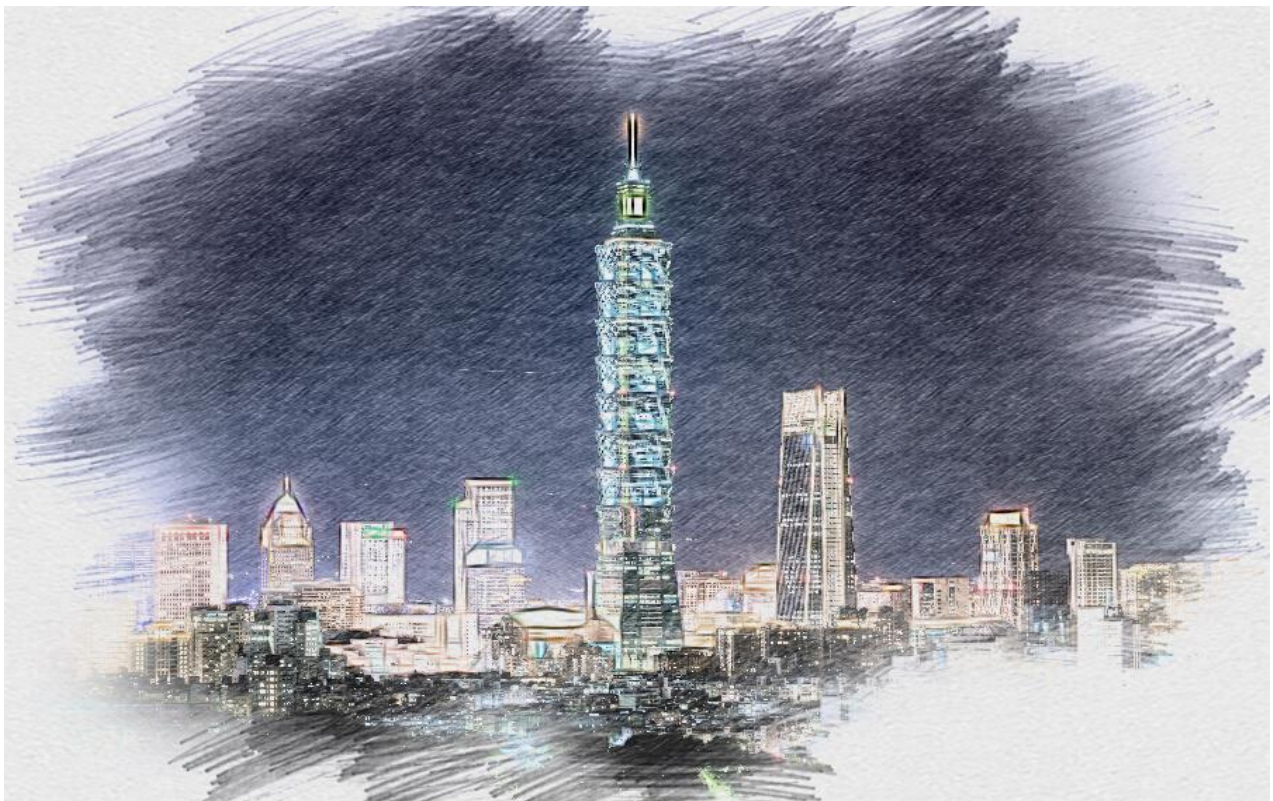
Gymnasium 3F
Education Building 3F Conference Room I
General Building 509

Organized by:

Institute for Research Excellence in Learning Sciences, NTNU
Taiwan E-Learning and Digital Content Association (TELDCA)
The School of Learning Informatics, NTNU

Sponsors:

Ministry of Science and Technology
Higher Education Sprout Project, Ministry of Education
National Taiwan Normal University



The Third International Conference for “Personal Epistemology and Learning in the Digital Age”

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Conference Purpose:

Personal epistemology refers to individuals' beliefs about the nature of knowledge and knowing. This conference, with the theme of "Personal Epistemology and Learning (PEL)," is devoted to elaborating the interplay between personal epistemology and learning. This conference will discuss how personal epistemology may play a role in the learning process and outcome. In addition, instruction, curriculum design, emerging technologies, and the cultural impacts on the development of personal epistemology have received growing interests among researchers. It is encouraged that international researchers and practitioners contribute papers for presentation at the 3rd PEL conference to share their research findings and best practices, as well as exchange updated views of recent development in the field.

Conference Chair:

Prof. Chin-Chung Tsai

National Taiwan Normal University, Taiwan (*Co-Editor of Computers & Education, Editor of International Journal of Science Education*)



Chin-Chung Tsai holds a B.Sc. in physics from National Taiwan Normal University. He received a Master of Education degree from Harvard University and completed his doctoral study at Teachers College, Columbia University in 1996. He currently serves as a co-editor in the journal of *Computers & Education* (indexed in SSCI, SCI) and is one of the editors of *International Journal of Science Education* (indexed in SSCI). From 1996 to 2006, he joined the faculty of the Institute of Education and Center for Teacher Education at

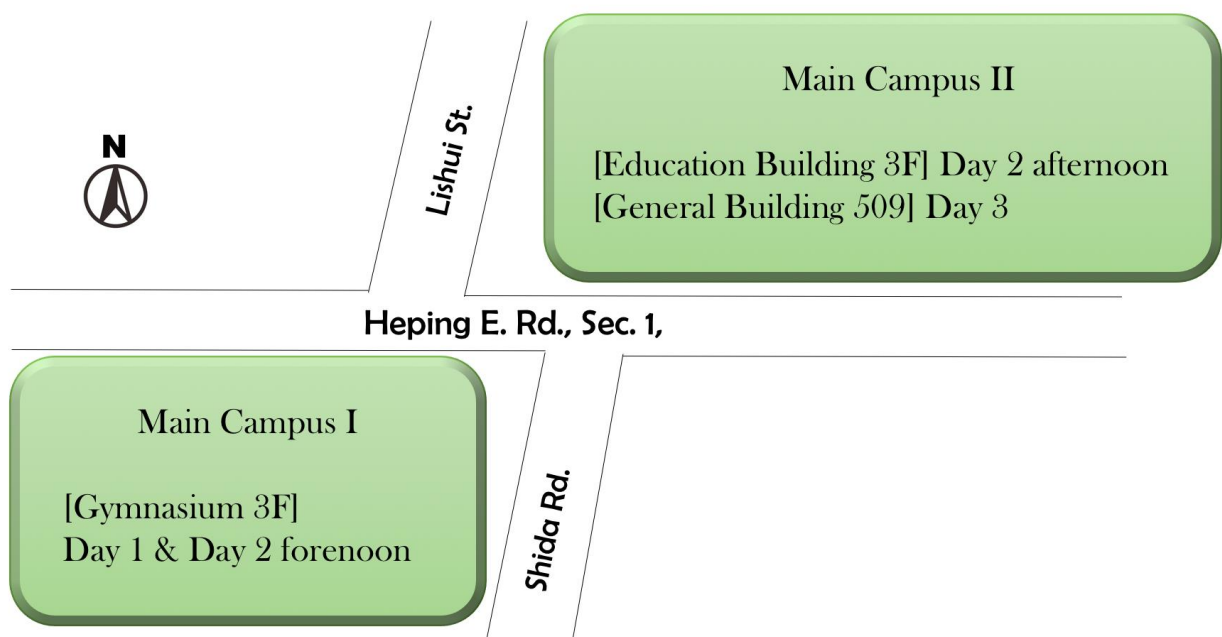
National Chiao Tung University, Taiwan. He was a Chair Professor at the Graduate Institute of Digital Learning and Education, National Taiwan University of Science and Technology, Taipei, Taiwan, from 2006 to 2017. He is currently a Chair Professor and Head for Program of Learning Sciences, National Taiwan Normal University. He is also affiliated with the Institute for Research Excellence in Learning Sciences, National Taiwan Normal University. His research interests deal largely with constructivism, epistemic beliefs, and Internet-based instruction related to science education. In the last five years, he has published more than 100 papers in English-based international journals. His research work has been published in *Computers & Education, Computers in Human Behavior, Educational Research Review, Instructional Science, International Journal of Science Education, Journal of Engineering Education, Journal of Research in Science Teaching, Learning and Instruction, Science Education, Teaching & Teacher Education* and other important educational journals.

Topics for the conference

- A1: Epistemology and thinking in interdisciplinary context
- A2: Epistemology in technology-supported learning environment (I)
- A3: Conceptions of learning science
- B1: Teachers' beliefs
- B2: Epistemology among science learners
- B3: Trend of epistemic development
- C1: Design beliefs and thinking
- C2: Epistemology in technology-supported learning environment (II)

Venues maps

PEL2019 VENUES MAP OF NTNU



Campus I



國立臺灣師範大學

National Taiwan Normal University Map (Main Campus I)

校本部配置圖



Campus II



國立臺灣師範大學

National Taiwan Normal University Map (Main Campus II)

校本部II配置圖



Program

Day 1 (Nov. 28, 2019) Thursday Venue: Gymnasium 3F (Main Campus I) 金牌講堂			Location
	09:00-09:30	Registration	Gymnasium 3F
	09:30-09:40	Opening Ceremony	Gymnasium 3F
Forenoon 1	09:40-10:40	Keynote Speech (I) <u>Teaching critical reading and thinking through epistemic cognition: A classroom based approach</u> Keynote Speaker: Professor Ivar Bråten <i>University of Oslo, Norway</i> Chair: Professor Chin-Chung Tsai National Taiwan Normal University, Taiwan	Gymnasium 3F
	10:40-11:00	Tea Break	
Forenoon 2	11:00-12:40	Paper presentation (Session A1) <i>Topic: Epistemology and thinking in interdisciplinary context</i> Presider: Professor Tan Seng Chee <i>Nanyang Technological University, Singapore</i> <i>Relationships between students' justification beliefs and eye-tracking measures during the reading of conflicting socio-scientific reports</i> Ching-Yeh Wang, National Taiwan Normal University, Taiwan Meng-Jung Tsai, National Taiwan Normal University, Taiwan <i>Exploring the relationship between middle school students' conceptions of learning STEM, STEM self-efficacy beliefs and approach of learning STEM</i> Seng Yue Wong, University of Malaya, Malaysia <i>Review on the Relationship between Epistemological Beliefs and Higher-Order Thinking</i> Dandan Wu, Macquarie University, Australia Zhi Hong Wan, The Education University of Hong Kong, Hong Kong S.A.R. China <i>Validating an instrument for epistemic awareness of scientific model and modeling and investigating its relationship to scientific epistemic beliefs</i> Silvia Wen-Yu Lee, National Changhua University of Education, Taiwan Hung-Ming Lin, Minghsin University of Science and Technology, Taiwan <i>Examining critical incidents and critical timing of epistemic beliefs changes in young teenagers</i> Wincy Wing Sze Lee The Education University of Hong Kong	Gymnasium 3F
	12:40-13:30	Lunch	

Afternoon 1	13:30-14:10	<p>Invited Speech (I)</p> <p><i>Personal epistemology in specific contexts of modeling and reasoning</i></p> <p>Invited Speaker: Professor Hsin-Yi Chang National Taiwan Normal University, Taiwan</p> <p>Chair: Professor Fang-Ying Yang National Taiwan Normal University, Taiwan</p>	Gymnasium 3F
Afternoon 2	14:10-15:10	<p>Paper presentation (Session A2) <i>Topic: Epistemology in technology-supported learning environment (I)</i></p> <p>Presider: Professor Hsin-Yi Chang National Taiwan Normal University, Taiwan</p> <p><i>Transformative learning functions and constructivist mobile learning environment preference and the impact of mobile self-efficacy for high school students</i> Ching-Jung Chung, National Taiwan Normal University, Taiwan Chiu-Lin Lai, National Taipei University of Education, Taiwan</p> <p><i>Exploring elementary school students' justification belief and perceptions in a mobile role-playing game-based learning environment</i> Chih-Hung Chen, National Taichung University of Education, Taiwan Chin-Chung Tsai, National Taiwan Normal University, Taiwan</p> <p><i>Internet-specific epistemic beliefs and learning engagement in MOOC-supported blended learning environment: An exploratory study</i> Tonny Menglun Kuo, National Tsing Hua University, Taiwan Jian-Wei Tzeng, National Tsing Hua University, Taiwan Chin-Chung Tsai, National Taiwan Normal University, Taiwan</p>	Gymnasium 3F
	15:10-15:30	Tea Break	
Afternoon 3	15:30-17:30	<p>Paper presentation (Session A3) <i>Topic: Conceptions of learning science</i></p> <p>Presider: Professor Aik-Ling Tan Nanyang Technological University, Singapore</p> <p><i>Singaporean students' conception of learning science: An exploratory study</i> Aik-Ling Tan, Nanyang Technological University, Singapore Jyh-Chong Liang, National Taiwan Normal University, Taiwan Chin-Chung Tsai, National Taiwan Normal University, Taiwan</p> <p><i>How Thai high school biology students construct scientific explanation?: The evidence for the relationship of conceptions of learning, self-efficacy, and epistemic beliefs</i> Witoon Inpeng, Khon Kaen University, Thailand Parichat Saenna, Khon Kaen University, Thailand</p> <p><i>Conceptions of learning science of rural Thais high school</i> Nawarat Boonsawadkulchai, Khon Kaen University, Thailand Parichat Saenna, Khon Kaen University, Thailand Jyh-Chong Liang, National Taiwan Normal University, Taiwan</p> <p><i>Conceptions of learning and approaches to learning science of students in general and gifted programs</i> Lakkhana Tarasri, Khon Kaen University, Thailand Parichat Saenna, Khon Kaen University, Thailand</p>	Gymnasium 3F

		<p><i>Investigating undergraduate engineering students' beliefs about the nature of knowledge and knowing in Science: An Indian context</i> Kaushal Kumar Bhagat, Indian Institute of Technology Kharagpur, India Fang-Ying Yang, National Taiwan Normal University, Taiwan</p> <p><i>Conceptions of learning science among some Asian countries</i> Chin-Chung Tsai, National Taiwan Normal University, Taiwan Aik-Ling Tan, Nanyang Technological University, Singapore Parichat Saenna, Khon Kaen University, Thailand Seng Yue Wong, University of Malaya, Malaysia Jyh-Chong Liang, National Taiwan Normal University, Taiwan</p>	
<p>Day 2 (Nov. 29, 2019) Friday</p> <p>Venue: Gymnasium 3F (Main Campus I) 金牌講堂- <i>Forenoon</i> Education Building 3F Conference Room I (Main Campus II)- <i>Afternoon</i></p>			Location
	09:00-09:30	Registration	Gymnasium 3F
Forenoon 1	09:30-10:30	<p>Keynote Speech (II)</p> <p><u><i>Epistemic beliefs of teacher students and teachers: variable-oriented and person-oriented views</i></u></p> <p>Keynote Speaker: Professor Kirsti Lonka <i>University of Helsinki, Finland</i></p> <p>Chair: Professor Ivar Bråten <i>University of Oslo, Norway</i></p>	Gymnasium 3F
	10:30-10:50	Tea Break	
Forenoon 2	10:50-12:50	<p>Paper presentation (Session B1) <i>Topic: Teachers' beliefs</i></p> <p>Presider: Dandan Wu <i>Macquarie University, Australia</i></p> <p><i>Preservice teachers' beliefs about teaching knowledge</i> Leila E. Ferguson, Kristiania University College, Norway</p> <p><i>Exploring the relationships among mathematics teachers' conceptions and commitment in China</i> Wei Lin, South China Normal University, Guangzhou, China; Shenzhen Institute of Educational Science Research, Shenzhen, China Hongbiao Yin, Chinese University of Hong Kong, Hong Kong SAR, China Ching-Sing Chai, Chinese University of Hong Kong, Hong Kong SAR, China</p> <p><i>Measuring teachers' epistemic beliefs and practices in two cultural contexts</i> Heidi Lammassaari, University of Helsinki, Finland Kirsti Lonka, University of Helsinki, Finland Sufen Chen, National Taiwan University of Science and Technology, Taiwan Chin-Chung Tsai, National Taiwan Normal University, Taiwan</p>	Gymnasium 3F

		<p><i>Finnish teachers' epistemic theories, new epistemic aims of their work and the manifestation of work engagement and burnout symptoms</i> Heidi Lammassaari, University of Helsinki, Finland Kirsti Lonka, University of Helsinki, Finland Lauri Hietajärvi, University of Helsinki, Finland</p> <p><i>The role of science epistemic beliefs in predicting science teaching beliefs among Chinese pre-service kindergarten teachers</i> Dandan Wu, Macquarie University, Australia Ting Liao, Zhanjiang Preschool Education College, China Weipeng Yang, Singapore University of Social Sciences, Singapore Hui Li, Macquarie University, Australia</p> <p><i>Thai pre-service physics teachers' conceptions of learning physics — How are they related to their preparing a lesson plan in a real physics class?</i> Kreetha Kaewkhong, Chiang Mai University, Thailand Nikom Pongprasert, Chiang Mai University, Thailand Phakin Buranakrue, Chiang Mai University, Thailand</p>	
	12:50-13:30	Lunch	
Afternoon 1	13:30-14:10	<p>Invited Speech (II)</p> <p><u>Conceptions of knowledge creation in education: a phenomenography of Singapore Chinese language teachers</u></p> <p>Invited Speaker: Professor Seng Chee Tan and Yuh Huann Tan <i>Nanyang Technological University, Singapore</i></p> <p>Chair: Professor Carol Chan <i>The University of Hong Kong, China</i></p>	Education Building 3F Conference Room I
Afternoon 2	14:10-14:50	<p>Invited Speech (III)</p> <p><u>Epistemic cognition and motivation: How do these concepts relate?</u></p> <p>Invited Speaker: Professor Christian Brandmo <i>University of Oslo, Norway</i></p> <p>Chair: Professor Meng-Jung Tsai <i>National Taiwan Normal University, Taiwan</i></p>	Education Building 3F Conference Room I
	14:50-15:10	Tea Break	
Afternoon 3	15:10-17:10	<p>Paper presentation (Session B2) <i>Topic: Epistemology among science learners</i></p> <p>Presider: Parichat Saenna <i>Khon Kaen University, Thailand</i></p> <p><i>Science academic hardiness and leaning achievement of urban Thai 10th</i> Pitchayapa Chompoonuch, Khon Kaen University, Thailand Parichat Saenna, Khon Kaen University, Thailand Jyh-Chong Liang, National Taiwan Normal University, Taiwan</p>	Education Building 3F Conference Room I

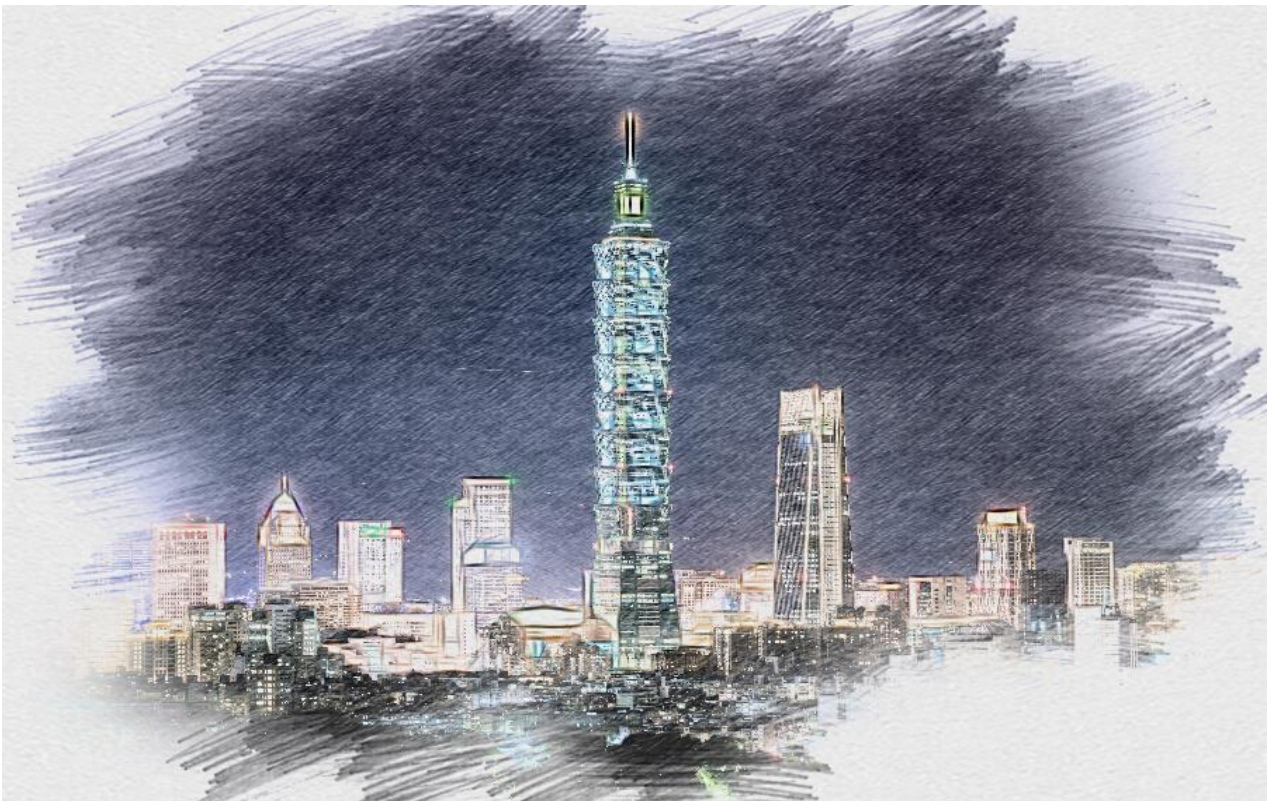
	<p><i>Scientific epistemological beliefs and academic performance of high school biology students</i> Mayurachat Yonwilat, Khon Kaen University, Thailand Parichat Saenna, Khon Kaen University, Thailand</p> <p><i>Culture and learning science: Exploring secondary school student's epistemological beliefs in northeast Thailand</i> Parichat Saenna, Khon Kaen University, Thailand</p> <p><i>An exploratory study on Taiwanese high school students' beliefs about knowing and learning engagement in science</i> Tzung-Jin Lin, National Taiwan Normal University, Taiwan</p> <p><i>The relationship between scientific epistemic beliefs and conception of learning science and academic performance in Thailand university students</i> Wisanutorn Nammungkhun, Khon Kaen University, Thailand Chaiyapong Ruangsawan, Khon Kaen University, Thailand Fang-Ying Yang, National Taiwan Normal University, Taiwan Sukanya Ruangsawan, Khon Kaen University, Thailand</p> <p><i>Exploring middle school children's science epistemic beliefs: Implications for measurement</i> Jo Lunn, Queensland University of Technology, Australia Leila Ferguson, Kristiania University College, Norway Garth Stahl, University of South Australia, Australia Laura Scholes, Australian Catholic University, Australia Barbara Comber, University of South Australia, Australia Sarah McDonald, University of South Australia, Australia Reece Mills, Queensland University of Technology, Australia</p>	
	<p>17:10-17:20 Break</p>	
	<p>17:20-18:00 Paper presentation (Session B3) <i>Topic: Trend of epistemic development</i></p> <p>Presider: Professor Kirsti Lonka <i>University of Helsinki, Finland</i></p> <p><i>A literature survey of epistemic research (2000-2018): International publication patterns and research trends</i> Kai-Yu Tang, Ming Chuan University, Taiwan Chin-Chung Tsai, National Taiwan Normal University, Taiwan</p> <p><i>University students' epistemic profiles and their relations to conceptions of learning and academic progress: A longitudinal study</i> Elina E. Ketonen, University of Helsinki, Finland Kirsti Lonka, University of Helsinki, Finland & Optentia Research Focus Area, NWU, South Africa Jan D. Vermunt, Eindhoven University of Technology, The Netherlands & University of Cambridge, United Kingdom</p>	<p>Education Building 3F Conference Room I</p>

Day 3 (Nov. 30, 2019) Saturday Venue: General Building 509 (Main Campus II)			Location
	09:00-09:30	Registration	General Building 509
Forenoon 1	09:30-10:30	Keynote Speech (III) <u>Primary school student's conception of knowledge building and their epistemic beliefs in the context of social studies</u> Keynote Speaker: Professor Ching Sing Chai <i>The Chinese University of Hong Kong, China</i> Chair: Professor Huang-Yao Hong <i>National Chengchi University, Taiwan</i>	General Building 509
Forenoon 2	10:30-11:10	Invited Speech (IV) <u>Promoting epistemic cognition in knowledge building: Discourse, tools, and analytics</u> Invited Speaker: Professor Bodong Chen <i>University of Minnesota–Twin Cities, USA</i> Chair: Professor Ching Sing Chai <i>The Chinese University of Hong Kong, China</i>	General Building 509
	11:10-11:30	Tea Break	
Forenoon 3	11:30-12:10	Paper presentation (Session C1) <i>Topic: Design beliefs and thinking</i> Presider: Professor Christian Brandmo <i>University of Oslo, Norway</i> <i>Exploring the relationships between pre-service teacher's design behaviours and their design belief</i> Chih-Hui Seet, National Chengchi University, Taiwan Huang-Yao Hong, National Chengchi University, Taiwan <i>Conceptualizing design thinking as a knowledge creation model in teaching context</i> Nanxi Chen, National Chengchi University, Taiwan Huang-Yao Hong, National Chengchi University, Taiwan Ching Sing Chai, The Chinese University of Hong Kong, Sha Tin, Hong Kong	General Building 509
	12:10-13:00	Lunch	
Afternoon 1	13:00-13:40	Invited Speech (V) <u>Promoting epistemic and conceptual change through knowledge building</u> Invited Speaker: Professor Carol Chan <i>The University of Hong Kong, China</i> Chair: Professor Bodong Chen <i>University of Minnesota–Twin Cities, USA</i>	General Building 509

Afternoon 2	13:40-14:40	<p>Paper presentation (Session C2) <i>Topic: Epistemology in technology-supported learning environment (II)</i> Presider: Yanjie SONG <i>The Education University of Hong Kong, Hong Kong, PRC</i></p> <p><i>The relationship between epistemic emotions and learning achievements in massive open online course</i> Zhong-Mei Han, South China Normal University, China Chang-Qin Huang, South China Normal University, China & Zhejiang Normal University, China Jian-Hui Yu, Zhejiang Normal University, China Chin-Chung Tsai, National Taiwan Normal University, Taiwan</p> <p><i>A case study of changes of fourth-grade students' epistemological beliefs in science learning leveraged by a mobile learning platform</i> Yanjie SONG, The Education University of Hong Kong, Hong Kong, PRC</p> <p><i>The effects of the cloud-based epistemic prompting on university students' multimodal multiple-document reading</i> Yuan-Hsuan Lee, National Tsing Hua University, Taiwan</p>	General Building 509
	14:40-15:00	Tea Break	
Afternoon 2	15:00-16:30	<p>Panel Discussion</p> <p><u>Research trends in personal epistemology and learning in the digital age</u></p> <p>Presider: Professor Chin-Chung Tsai National Taiwan Normal University, Taiwan</p> <p>Discussants: Professor Ivar Bråten, University of Oslo, Norway Professor Kirsti Lonka, University of Helsinki, Finland Professor Ching Sing Chai, The Chinese University of Hong Kong, China Professor Carol Chan, The University of Hong Kong, China Professor Seng Chee Tan, <i>Nanyang Technological University, Singapore</i> Professor Christian Brandmo, University of Oslo, Norway Professor Hsin-Yi Chang, National Taiwan Normal University, Taiwan Professor Bodong Chen, University of Minnesota–Twin Cities, USA</p>	General Building 509
	16:30-17:00	Closing Ceremony	General Building 509

Program session format

In a paper session, the presider introduces the presenters and monitors the time used for each presentation. Each paper will be allocated a total of 20 minutes, including 15 minutes of oral presentation and 5 minutes of questions or discussion. The presider and audience will use any time remaining in the session for additional discussion, general review, and suggestions for further research.



Keynote Speech
(I), (II), & (III)

Keynote Speaker (I)

Prof. Ivar Bråten

(Department of Education, University of Oslo, Norway)



Ivar Bråten is a professor of educational psychology in the Department of Education at the University of Oslo, Norway, where he is the head of the Critical Reading and Learning Lab (CRALL). Among his research interests are epistemic cognition and multiple document literacy, and he has given a large number of talks around the world on these topics. His publication list totals nearly 350 titles, including 10 authored or edited

books and approximately 150 international peer-reviewed articles and book chapters, co-authored with over 60 different scholars from 11 different countries. He currently serves on the editorial review boards of *Contemporary Educational Psychology*, *Discourse Processes*, *Learning and Individual Differences*, *Learning and Instruction*, *Metacognition and Learning*, and *Reading Research Quarterly*. Ivar Bråten is a co-editor of the *Handbook of Epistemic Cognition* (Routledge, 2016) and the *Handbook of Multiple Source Use* (Routledge, 2018).

Teaching critical reading and thinking through epistemic cognition: A classroom based approach

Ivar Bråten
University of Oslo, Norway

Epistemic cognition concerning sources of knowledge can be defined as attending to, representing, evaluating, and using available or accessible information about the sources of knowledge claims, for example about the author or publisher. This aspect of epistemic cognition has become more important due to the abundance of easily accessible information on almost every issue that characterizes the Internet age. In this talk, I will argue that designing, implementing, and evaluating interventions to promote adaptive epistemic cognition concerning sources of knowledge is a way to promote critical reading and thinking among students and, as such, an important research agenda within personal epistemology. In particular, I will present a recent quasi-experimental study that tested the effects of an intervention designed to teach upper-secondary school students to take sources of knowledge into consideration when selecting, processing, and using information resources to complete particular multiple document literacy tasks. The intervention centered on a contrasting cases approach framed by authentic curriculum-based classroom activities and was implemented over six weeks by teachers who had participated in professional development seminars. The findings demonstrated that students who had participated in the intervention placed more value on sources of knowledge when selecting information resources, invested more time and effort in processing the information resources they selected, and more frequently attributed ideas to their respective sources compared to students who instead had participated in typical classroom activities. These effects were observed on far transfer tasks where students worked with information resources on different topics in different situational contexts for different purposes and were sustained over a period of five and a half weeks.

Keynote Speaker (II)

Prof. Kirsti Lonka

(Educational psychology, Faculty of Behavioural Sciences, University of Helsinki, Finland)



Kirsti Lonka is Professor of Educational Psychology at University of Helsinki, Finland (2005-). On growingmind.fi you may see all her projects and also people working with her. She is Director of Research Group of Educational Psychology. Kirsti is Extraordinary Professor, Optentia Research Focus Area, North-West University, Vanderbiljpark, South Africa (2016-2019) and Advisory Board Member of Graduate Institute of Digital Learning and Education, National Taiwan University of Science and Technology (NTUST 2015-). She is also Science Rector of Kymenlaakso Summer

University. Kirsti is a founding member of Teachers' Academy of University of Helsinki since 2013 and was their first President (2013-2014). Kirsti Lonka is a PI of a project "Phenomenal Teacher Education – Engaging learning environments" funded by Ministry of Education, Finland (2017-2020) and PI in collaboration with Dr. Markus Talvio in EU Erasmus+ project Learning2Be (on social and emotional learning) (2017-2019). Professor Lonka's current project as a CO-PI is Bridging the Gap – Affective, cognitive, and social consequences of digital revolution for youth development and education (2018 – 2020) funded by Academy of Finland (PI Professor Katariina Salmela-Aro). Kirsti Lonka is a popular keynote speaker around the world. She has published more than hundred refereed articles as well as conference papers and book chapters. She has also published textbooks and popular writings. Her specialty is learning in higher education, teacher education, and postgraduate education (PhD students). At the moment, she is working on innovations in higher education and engaging learning environments (ELE). Professor Lonka is active on Twitter and Instagram (@kirstilonka), on Facebook and LinkedIn. Her latest book is Lonka, K. (2018) *Phenomenal learning from Finland*. Edita Publishing.

Epistemic beliefs of teacher students and teachers: Variable-oriented and person-oriented views

Kirsti Lonka
University of Helsinki, Finland

The present keynotes approaches the personal epistemologies of university students and teachers. Previously, there have been lack of instruments that would capture complex epistemic beliefs. We applied the modified MED NORD (Lonka et al., 2008) instrument to measure epistemic beliefs of university students and professional teachers. First, we examined university students' epistemic profiles and their relations to conceptions of learning, age, gender, discipline and grades. We measured epistemic beliefs: Reflective learning, collaborative knowledge-building, valuing metacognition, certain knowledge and practical value. The participants were 1515 students from five faculties who completed questionnaires about epistemic beliefs. We analyzed structural validity using confirmatory factor analysis (CFA). We examined epistemic profiles using latent profile analysis (LPA). Three-class LPA solution fit the data: Fact-oriented (25%), collaborative-reflective (26%), and practical fact-oriented (49%) groups. We compared age, discipline and grades across the profiles. The profiles' conceptions of learning varied: The collaborative-reflective group were more likely to be female, teacher- and mature students, and they had the highest academic achievement. The fact-oriented group were mostly engineering or science students. The practical fact-oriented group were often law students. Teacher students expressed the most sophisticated epistemic beliefs in the student population. Later, we It measured the following epistemic beliefs among teachers: collaborative knowledge building, valuing metacognition, certainty of knowledge, and simple (surface) learning. In the two-part statements, statement A always measured the ideal epistemic beliefs, whereas statement B concerned how willing the teachers were to apply them in practice. The participants were 228 subject matter teachers from Finland and 97 teachers from Taiwan. Two factors were confirmed in both cultures: 1) reflective-collaborative theory and 2) knowledge transmission theory. It appeared that there were both similarities across cultures as well as differences in line with previous research. In conclusion, the modified MED NORD questionnaires were reliable and valid tools that captured some essential aspects of both teachers' and students' epistemic beliefs. In the present keynote, I shall look how epistemic beliefs are related to well-being and approaches to modern ideas of learning and assessment. The added value of person-oriented approach is also discussed. I shall also look at how the results are generalised into teachers of five different European countries.

Keynote Speaker (III)

Prof. Ching Sing Chai

(Department of Curriculum and Instruction, The Chinese University of Hong Kong, China)



Ching Sing Chai is a Professor at The Chinese University of Hong Kong, China. He served as a school teacher and head of department after he completed his B.A. from National Taiwan University with scholarship from the Ministry of Education (Singapore). He joined the National Institute of Education after completing his Master degree in Nanyang Technological University 2001, and subsequently finished his Ed. D with the University of Leicester in 2006. His research interests are in the areas of Technological Pedagogical Content Knowledge (TPACK), teachers' beliefs, design epistemology and students' learning with ICT. He has published more than 80 journal articles in reputable journals listed in the Social Science Citation Index. He has also co-authored several monographs including the recently published "Design Thinking for Education: Conceptions and Applications in Teaching and Learning", a Springer-published book. Currently, he works with Hong Kong teachers in designing AI integrated lessons and integrative STEM lessons.

Primary school student's conception of knowledge building and their epistemic beliefs in the context of social studies

Ching Sing Chai

The Chinese University of Hong Kong, China

Knowledge building (KB) has been advocated as a deep constructivist approach that build students' capacity for knowledge creation. Given its pedagogical essence, it seems necessary that students participating in KB learning environment need to possess appropriate epistemic stance. Nonetheless, few studies on students' epistemic beliefs or their conceptions and approaches to KB have been conducted. This study validated an instrument that measured students' conception of KB (i.e. KB as accumulating knowledge and KB as negotiating ideas integration) and approaches of KB (Seeking information and adding ideas and Building and refining ideas). In addition, an epistemic survey adapted from previous research measured students' certainty of knowledge; authority sources of knowledge; Knowledge development; and Justification of knowledge. The survey was administered to 247 primary school students who have participated in KB for their social studies for one year or more. The survey was validated and most factors were found to be correlated. The mean scores indicated that the students possessed relatively advanced epistemological beliefs and they agreed with both shallow and deep conceptions and approaches of KB with mean scores for the four factors all above 4. Structural equation modelling indicated that justification predicts all factors of KB conceptions and approaches. The study provides evidences that KB is intertwined with students' epistemic beliefs and future research should study the reciprocal relationships between KB and epistemic belief over time.

Invited Speech
(I), (II), (III), (IV), & (V)

Invited Speaker (I)

Prof. Hsin-Yi Chang

(Program of Learning Sciences, National Taiwan Normal University, Taiwan)



Hsin-Yi Chang is a Professor at the Program of Learning Sciences, National Taiwan Normal University. She received her Ph.D. (Science Education) from University of Michigan in 2007 and Master's degree (Science Education) from National Taiwan Normal University in 1997. She was a science teacher at high schools in Taiwan and a postdoctoral researcher at University of California, Berkeley. Her research interests include design of science inquiry learning environments and assessments, use of computer simulations and visualizations to support science learning, and design-based research.

Personal Epistemology in Specific Contexts of Modeling and Reasoning

Hsin-Yi Chang

National Taiwan Normal University, Taiwan

The issue that the general model of personal epistemology has multiple dimensions that may or may not be applicable in different disciplines or contexts has drawn much attention in recent research (Sandoval, Greene, & Bråten, 2016). In this talk, two specific contexts in science education are focused on, namely, metavisualization and socioscientific reasoning. It has been found that fluent creation and uses of scientific models, representations, or visualizations require metavisualization (Hung, Chang, & Hung, 2019). However, the theory of metavisualization is still developing. In this talk, a model of metavisualization will be introduced that distinguishes and relates among constructs of metavisualization, visualization, metacognition, and epistemic knowledge of scientific modeling. The model was proposed based on a study investigating how and why a science teacher is a fluent user and an efficient teacher of working with visual representations. Meanwhile, reflections will be made on how the teacher's metavisualization practice relates to epistemic cognition and how the model of metavisualization connects to the model of personal epistemology. Socioscientific reasoning is another context in science education that seems to heavily involve epistemic cognition. Specifically, a recent study on how students' context-specific epistemic justifications may contribute to their socioscientific reasoning and engagement will be introduced and discussed. Finally, reflections on how the findings from the metavisualization and socioscientific reasoning studies provide insights into the model of personal epistemology will be made to spur further discussion and future collaboration.

Invited Speaker (II)

Prof. Seng Chee Tan and Yuh Huann Tan

(National Institute of Education, Nanyang Technological University, Singapore)



Tan Seng Chee is the Associate professor with the Learning Sciences and Technologies academic group, National Institute of Education, Nanyang Technological University, Singapore. He obtained his BSc (Hons) in Chemistry from the National University of Singapore in 1989 and completed his Master in Education from the National Institute of Education in 1997. He obtained his Ph.D. (Instructional Systems) from the Pennsylvania State University in 2000 under the Overseas Graduate Scholarship from the National Institute of Education. His research interest is in the area of Computer-Supported Collaborative Learning

and Knowledge Building. He has supervised and graduated more than 7 doctoral students and 17 Master's students.

Conceptions of knowledge creation in education: A phenomenography of Singapore Chinese language teachers

Seng Chee Tan and Yuh Huann Tan
Nanyang Technological University, Singapore

This talk presents a phenomenographic account of how Singapore Chinese Language teachers interpret the phenomenon of knowledge creation in education. The advent of the Knowledge Age saw increasing demand for knowledge workers in the workforce, which has ramification on education: Is education in schools changing fast enough to prepare our young for the Knowledge Age? Bereiter observed that most transformation in schools focus on structural or administrative changes, but a more radical and necessary change is to transform schools to knowledge building organizations. Consequently, Scardamalia and Bereiter initiated research on knowledge building pedagogy in schools. To implement knowledge building in classrooms, teachers play critical roles in facilitating students' work and in developing students' capacity in collaborative idea improvement. Yet, we do not know much about teachers' understanding of knowledge creation in education as a phenomenon, a gap that this study attempts to address. This study involved 16 Chinese Language teachers in Singapore, an interesting context of study because Singapore is a multi-racial Asian society comprising about 70% of Chinese, yet English is the lingua franca among the Singaporeans, an indelible influence from its colonial history. This study adopted the phenomenography method, a qualitative research methodology aims at finding and systematising how people interpret the world around them. We chose Chinese language teachers as the participants because they potentially possess an understanding of the different phenomena that reflect the influence of the Chinese culture by virtue of the language they speak and teach. The findings show that the teachers' conceptions vary along three dimensions: (a) types of knowledge creator and contexts (student or teacher, out of school or in school); (b) knowledge creation as an individual or group efforts; (c) the purpose of knowledge creation (for learning of Chinese language or other purposes). The teachers also conceived the outcomes of knowledge creation as materials, processes, and mental constructs; they talked about benefits of knowledge creation for teachers and students, as well as the enabling conditions and hindrances to knowledge creation. We compare the findings with prominent theories of knowledge creation, including the knowledge building pedagogy; we also hypothesize the possible cultural influence on these teachers' conception.

Invited Speaker (III)

Prof. Christian Brandmo (Department of Special Needs Education, University of Oslo, Norway)



Christian Brandmo is an associate professor in the Department of Special Needs Education at the University of Oslo, Norway, where his position is related to quantitative research methodology, motivation and learning science. He worked as a school psychologist until he started his research career and graduated as a PhD on a dissertation related to higher education students' epistemic beliefs, motivation and self-regulation. Before he moved to his current position, he worked seven years as an associate professor in the Department of Teacher Education and School

Research at the University of Oslo, linked to the field of educational leadership. During this period, he also served as a department deputy and department head of research. His publications are related to topics such as epistemic cognition, motivation, self-regulated learning, and reading comprehension in various groups (students, teachers, and school leaders) and contexts. He has also edited two special issues on self-regulated learning for the *Journal of Cognitive Education and Psychology*. He is member of the research group on Text Comprehension - Development, Instruction, and Multiple Texts (TextDIM), and is currently engaged in two research projects; a project on lower secondary students' motivation and achievement and a project on teachers' motivation and epistemic cognition during online reading. In addition, he is member of the Norwegian project-team of the 2018 Teaching and Learning International Survey (TALIS).

Epistemic cognition and motivation: How do these concepts relate?

Christian Brandmo
University of Oslo, Norway

Ever since Marlene Schommer (1990) introduced her multi-dimensional model of epistemological belief, researchers have discussed the distinction between personal epistemology concepts and motivation. Through the introduction of epistemic cognition as a general term in the field as well as the theoretical models related to this term, the question of a distinction between motivation and personal epistemology is more relevant than ever. In this talk, concepts from the field of epistemic cognition (e.g., epistemic aim, values) will be compared with concepts that traditionally have been associated with motivation (e.g., goals and values). Furthermore, based on theoretical models and empirical research from both the area of personal epistemology and the area of motivation, the function of various concepts on individuals' cognition and behavior will be discussed.

Invited Speaker (IV)

Prof. Bodong Chen

(Bonnie Westby Huebner Chair in Education & Technology, University of Minnesota–Twin Cities, USA)



Bodong Chen is an Associate Professor at the University of Minnesota–Twin Cities. He holds the Bonnie Westby Huebner Endowed Chair in Education & Technology and is the inaugural Director of the Learning Informatics Lab. His researches sits at the intersection of learning sciences, learning analytics, online learning, and network science. He develops digital learning environments and pedagogical practices for collaborative knowledge building. He also derives graph metrics of knowledge building discourse, applies relational event modeling to examining social dynamics in online discussions, and uses data mining to investigate teacher professional learning in MOOCs. He obtained his BSc from Beijing Normal University (2006), MEd from Peking University (2009), and PhD from the University of Toronto (2014).

Promoting epistemic cognition in knowledge building: Discourse, tools, and analytics

Bodong Chen

University of Minnesota–Twin Cities, USA

Epistemic cognition is about people's thinking about what they know and how they come to know. As a constructivist approach with unique onto-epistemological underpinnings, Knowledge Building (KB; Scardamalia & Bereiter, 2014) is deeply invested in facilitating epistemic cognition of learners. For example, the inculturation of learners into KB's theory-building discourse involves the exploration and development of learners' epistemic views; KB's supporting technology---Knowledge Forum---is built with epistemic scaffolds to promote epistemic diversity in the theory-building discourse. In this talk, I will discuss a line of research that aims to design discourse practices, tools, metrics, and analytics to promote epistemic cognition in KB. In the first study, we designed a "Discourse Moves tool" that visualizes epistemic diversity in a KB community. With this tool, we engaged a second grade class in metadiscourse about their discourse moves and salient concepts. Results indicated second graders' capability in reflecting on their epistemic moves and taking actions to enrich the epistemic diversity of their community. In the second study, I introduce my recent work on applying Network Science techniques to develop network representations of discourse data and derive network-based metrics of epistemic cognition. In this work, I conceptualize theory-building discourse in KB as a dynamic, multidimensional network involving epistemic agents, epistemic moves, ideas, and concepts. Epistemic cognition---of either an individual and a collective---is reflected in "meta-paths" and structural patterns of the multidimensional network. I will introduce nascent network-based metrics of epistemic cognition in KB discourse and discuss plans of developing analytics tools based on these metrics to promote epistemic cognition.

Invited Speaker (V)

Prof. Carol Chan

(Faculty of Education, The University of Hong Kong, China)



Carol Chan is a Professor at the Faculty of Education, The University of Hong Kong. She was a co-convener of the Strategic Research Theme on Science of Learning at HKU and a Visiting Fellow at University of Cambridge. Her research area is in Learning Sciences focusing on cognition, learning and instruction. For two decades, her research in knowledge building has focused on designing and assessing collaborative knowledge building supported with technology and examining the epistemic dynamics and socio-cultural processes of learning. Her other research interests include dialogic education and teacher learning. She is an Associate Editor of International Journal of Computer-Supported Collaborative Learning and she serves as Editorial

Board member of prestigious journals including Learning and Instruction and Journal of the Learning Sciences. She is also a recipient of both University Teaching and Faculty Outstanding Research Student Supervision Awards.

Promoting epistemic and conceptual change through knowledge building

Carol Chan

The University of Hong Kong, China

Pivotal to learning and development is the role of epistemic beliefs and epistemic cognition -- Promoting students' epistemic development takes on more significance in light of knowledge explosion, technology change and demands for creative knowledge work in the knowledge era. Increasing research interests have now been given to interventions for epistemic change in classrooms, and designing technology-enhanced learning environments for epistemic change and knowledge creation merits further investigation. In this talk, I will discuss theory, design and evidence of the Knowledge-Building (KB) model (Scardamalia & Bereiter, 2006; 2014) supported by Knowledge Forum®, for epistemic change, drawing from design-based studies with elementary-school students working on Knowledge Forum pursuing scientific inquiry. First, I will present the theoretical underpinning of KB, an epistemological theory, that posits how knowledge can be advanced through progressive and scientific dialogue – I will argue why the KB model supports epistemic change premised on the theory-building perspective. Second, pedagogy and design principles of KB focusing on collective idea improvement, enriched with meta-discourse, and linking novice with expert epistemology in a KB community will be examined. Third, how students engage in the meta-discourse processes supported by KF resulting in epistemic and conceptual growth will be examined. Theory, pedagogy and technology are integral in the KB approach – theoretical and design implications of KB for promoting students' epistemic and conceptual development will be discussed.

Paper presentation
Day 1

Session A1

Epistemology and thinking in interdisciplinary context

11:00-12:40 / Gymnasium 3F

Relationships between students' justification beliefs and eye-tracking measures during the reading of conflicting socio-scientific reports

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This study was to explore the relationship between students' justification beliefs and their eye-tracking indices during the reading of conflicting reports on social scientific issues. Forty-eight university and graduate students read an issue about artificial sweeteners, i.e., the aspartame, in a report which consisted of definition, reason, data, and inference sections for different position arguments. Participants' justification beliefs were self-reported in three dimensions (personal, authority, and multiple sources) before reading and their visual behaviors were tracked by an eye-tracker during reading. Correlation analyses results showed that different eye-tracking indices were significantly associated with different justification beliefs. Personal justification belief was negatively associated with the number of regressions on the reason section and the percentage of fixation counts on the data section. Authority justification belief was positively associated with the averaged fixation duration on the reason as well as the definition sections. Finally, multiple source justification belief was positively associated with the number of regressions on the data information. The eye-tracking indices could serve as diagnostic indices for justification beliefs.

Exploring the relationship between middle school students' conceptions of learning STEM, STEM self-efficacy beliefs and approach of learning STEM.

Seng Yue Wong *

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Conceptions of learning are highly related to their approaches of learning. Students who focus the importance of learning quality prefer to use deep approaches and strategies to learn. Self-efficacy is a significant predictor of students' motivation level and task performance. Students with high STEM self-efficacy perform better and persist longer compared to those lower in STEM self-efficacy. Hence, this study is aimed to find out the roles of conceptions of learning and self-efficacy beliefs in influencing their approaches of learning STEM. There are three questionnaires were adopted and modified for this study, named conceptions of learning STEM (COLSTEM), STEM self-efficacy beliefs (STEMSEB) and approaches of learning STEM (ALSTEM). A total of 83 middle school students in Malaysia, who are in age group of 13 – 16 years old (grades 7-10) have participated this study. These students have been explored STEM-based learning activities in their schools. All these activities mainly focused on enhancing students' interest for STEM, increasing students' enrolment in STEM-related subjects. Results show that deep strategy 'relating ideas and understanding' is significantly predicted based on students' conceptions, 'increasing one's knowledge', and their self-efficacy beliefs, 'physiological and affective state' as well as 'vicarious experience' in STEM learning. These three factors contribute 70.9% of the variances in affecting the use of relating ideas and understating as their deep strategy in STEM learning.

Review on the Relationship between Epistemological Beliefs and Higher-Order Thinking

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In order to reveal the complex relationship between Epistemological Beliefs (EB) and Higher-Order Thinking (HOT), this study reviews a total thirty-seven relevant empirical studies through a perspective of the dual-process theory (Evans, 2003; Sloman, 1996; cited by Wu & Tsai, 2011), based on which we specifically grouped these studies into three clusters, i.e., dispositions, process and performance of thinking. The review indicates that sophisticated EB may positively link with a more established thinking disposition system. Meanwhile, it is suggested that different dimensions of EB should be separately considered when examining its relationships with different layers and stages of HOT process. In addition, the review also suggests that there are many other factors collaborate with EB contributing to better HOT and so EB may be a necessary but not sufficient factor of HOT. These implications and suggestions for future study should be discussed at the conference.

Validating an instrument for epistemic awareness of scientific model and modeling and investigating its relationship to scientific epistemic beliefs.

Silvia Wen-Yu Lee ^{1*} and Hung-Ming Lin ²

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The epistemic awareness of models and modeling has been considered as part of the modeling competence which draws increasingly more attention in science education research. The nature of models and modeling is a part of the nature of science and is also a specialized aspect of the epistemology of science. The current research includes two parts. In the first part, the Epistemic Awareness of Scientific Model and Modeling (EASM) questionnaire was developed and validated. Four-hundred and seventy students from seventh to ninth grades in Taiwan were surveyed. The results of exploratory factor analysis showed that the EASM questionnaire is consisted of five subscales, including purpose of models, changing nature of models, nature of constructed models, multiple representation of models, and model evaluation. The second part of the study was to explore which aspects of the students' scientific epistemic beliefs (SEB) predict EASM. A total of three-hundred and two students in Taiwan completed both the EASM questionnaire and the SEB questionnaire. The SEB questionnaire includes four subscales, namely, uncertainty, multiple-source, development, and justification. Partial Least Square Structural Equation Modeling (PLS-SEM) was used to test the structural relationships between SEB's and EASM's subscales. Results of structural relationships test indicated that "justification" predicted all five subscales of EASM. The "development" subscale SEB also positively predicted "changing nature of models." The "multiple-source" negatively predicted "constructed nature of models." "Uncertainty" however, could not predict any of the EASM subscales. The role of SEB on the students' understanding of scientific models and modeling will be discussed.

Examining critical incidents and critical timing of epistemic beliefs changes in young teenagers

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What is knowledge and where does it come from? How people answer these two questions, and how their answers predict learning processes and outcomes have intrigued educational psychologists for three decades (Greene, Sandoval, & Braten, 2016). This strand of research is now known as epistemic beliefs (Hofer, 2016). Much work during earlier waves of the development in this field employed qualitative studies to examine learners' epistemic beliefs and the change mechanism but little has been done lately to further this work (Bendixen, 2002; Mason, 2016). The present study used the cognitive interview technique (Willis, 2005) to examine young learners' recollections of critical incidents that fostered epistemic beliefs changes. Nine participants, ranging from Grade 7 to Grade 11, were invited to participate in the study. The results showed that 8 out of 9 participants could recollect critical incidents that led successfully to epistemic beliefs changes. A total of 22 accounts of critical incidents was reported, suggesting that there could be dimension-specificity in epistemic beliefs change. Furthermore, when the critical incidents were coded by theme, it was found that most of them related to classroom context (teacher; assessment and subject content). The results of this study contribute to the understanding of epistemic beliefs change and may yield practical implications regarding the construction of epistemic climate that promotes this change.

Paper presentation

Day 1

Session A2

Epistemology in technology-supported learning environment (I)

14:10-15:10 / Gymnasium 3F

Transformative learning functions and constructivist mobile learning environment preference and the impact of mobile self-efficacy for high school students

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Mobile learning has been widely adopted for educational purposes in recent years. A mobile learning program funded by the Ministry of Education in Taiwan was conducted to help high school teachers implement mobile learning activities in the existing curriculums. This research investigated the high school students' perception of mobile learning self-efficacy and their constructivist mobile learning environment preferences based on the transformative learning theory. In this study, a web-based questionnaire was developed and responded by 407 high school students. Therefore, two questionnaires were adopted: mobile learning self-efficacy survey and constructivist mobile learning environment preferences survey (CMLEPS). By analyzing the collected data using the structural equation model (SEM), results show that the eight constructs of the constructive mobile learning environment preference scale (ease of use, continuity, relevance, adaptive content, multiple sources, timely guidance, student negotiation and inquiry learning) can be converged into three factors (technical, dialectical and emancipatory learning) of transformative learning theory. In addition, SEM further revealed that the provision of students' constructive mobile learning environment preference had positive impacts on the students' tendency to engage their mobile self-efficacy. Another important finding is the "mobile learning usage frequency" variable in this model could have some moderating effects on relationship between "timely guidance" and "higher order cognitive skills". These findings of this research provide a good reference for conducting future promotion technology-enhanced learning programs.

Exploring elementary school students' justification belief and perceptions in a mobile role-playing game-based learning environment

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Epistemology refers to an area of philosophy concerning the nature and justification of human knowledge (Hofer & Pintrich, 1997). Students' epistemic cognition can be characterized by one dimension regarding the certainty and simplicity of the nature of knowledge, and three dimensions regarding the justification for knowing, namely personal justification, justification by authority, and justification by multiple sources (Ferguson, Bråten, & Strømsø, 2012). This study probes the development of learners' advanced epistemologies in a mobile game-based learning environment via investigating their justification beliefs. Thus, a mobile role-playing game with a collaborative problem-based approach was designed according to the concept of "biology and environmental science." Moreover, an experiment was conducted on a natural science course in an elementary school to assess the effects of the implemented system on students' learning. A total of 24 sixth graders (11- or 12-year-olds) were recruited in this experiment. The experimental results display that the mobile role-playing game can significantly promote students' personal justification by integrating the gaming storyline with the learning contexts. In future research, it would be worth conducting a large-scale experiment or a quantitative survey for the investigation of personal epistemology in a mobile game-based learning environment.

**Internet-specific epistemic beliefs and learning engagement in MOOC-supported blended learning environment:
An exploratory study**

Tonny Menglun Kuo^{1*}, Jian-Wei Tzeng², and Chin-Chung Tsai^{3,4}

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With more and more available educational resources such as MOOCs and instructional video, contemporary learners are used to learning in a blended way (Broadbent, 2017). This study investigates how three kinds of epistemic justification (justification by authority, justification by multiple sources, and personal justification) increases learning engagement with a focus on four-aspect framework (i.e., behavioral, agentic, emotional, and cognitive engagement) in MOOC-supported blended environment. To verify our hypotheses, we collect survey data from one MOOC-supported blended course in a northern university in Taiwan. Using linear regression model, our data found a significant positive relationship between justification by authority and agentic engagement, indicating that individuals high in relying on reliable sources are more likely to actively participate in the online learning process to voice opinions and preferences online. Second, we found a high association between justification by multiple sources and cognitive engagement. This finding suggests that learners who acquire knowledge from multiple sources utilize more cognitive resources to help comprehend the learning content. Finally, our data found no significant association between justification and behavioral/emotional engagement in MOOC-supported blended environment.

Paper presentation

Day 1

Session A3

Conceptions of learning science

15:30-17:30 / Gymnasium 3F

**Singaporean students' conception of learning science:
An exploratory study**

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Inquiry as a form of learning in science has typically been touted as the gold-standard for learning science. Inquiry involved creating opportunities for students to engage in raising scientifically oriented questions, designing investigations to collect evidence to these questions, using the evidence to craft explanations and finally communicate the explanation in light of the evidence. In Singapore, teachers have been encouraged to teach science as a form of inquiry since 2008. It is hoped that engagement with scientific inquiry will enable students to develop a more accurate understanding of the nature of science. Using Conceptions of Science Learning Questionnaire (COLS), a total of 884 students were sampled to understand their perceptions of science learning. Results showed that Singaporean students show predominantly and statistically significant higher conceptions of science learning (increase one's knowledge, applying and understanding and seeing in a new way). While the lower conceptions of science learning (memorizing, testing and calculating) are still conceptions held by some students, they are less prevalent. While students' conceptions of science learning is evolving and there is no direct evidence to suggest that their conceptions are attributed to inquiry forms of learning, the results provide a valuable starting point for researchers to examine the progression of students' conceptions through time.

How Thai high school biology students construct scientific explanation?: The evidence for the relationship of conceptions of learning, self-efficacy, and epistemic beliefs

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During the last decades, the relationship between personal epistemological and learning outcomes or learning strategies remains uncertain. Although, previous studies found that students with more constructivist-oriented learning tended to have more higher-level conceptions of learning. Based on this finding, in this research, the scientific explanation has been identified as learning outcomes or deep-learning strategies. The purpose of this study was to investigate the relationships between high school biology students' epistemological (conceptions of learning biology; COLB, self-efficacy of learning biology; SOLB and scientific epistemic beliefs; SEB) and constructing scientific explanation by using COLB, SOLB and SEB questionnaire as well as scientific explanation test (SET). Two hundred-four high school students of science program from urban school in the Northeastern Thailand were participated in this research. PLS-SEM in Smart PLS 3.0 was used to test the proposed model. Results revealed that both COLB and SOLB were significantly positively associated with SET ($r=0.355$, $p<0.001$). While SEB was found to significantly negatively correlated with SET ($r=0.355$, $p<0.001$), but non-significantly positively correlated with SOLB ($r=0.192$, $p<0.001$). In contrast, COLB was directly negative correlated with SOLB ($r=0.192$, $p<0.001$). We found that SOLB can play as a mediator between SET and SEB. The results suggested that the students' beliefs play an important role in developing or maintaining individual's learning outcomes or learning strategies on biology learning. Therefore, teachers should not only focus on learning activities and learning achievement, but should also consider the need of incorporate student' beliefs with the activities for promote better learning.

Conceptions of learning science of rural Thais high school

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The conceptions of learning are found correlated with a deep effect on the learning process and learning outcomes. Previous researches have investigated and proposed the conceptions of learning held by students from various contexts. Indeed, students' education contexts are influence what they think learning is. The objective of this was to explore conceptions of learning science held by 7 students who are living and studying in a rural area. A semi-structure interview was used to collect data from each student. All individual interviews were later transcribed from audio recorded. The interview data gathered from these students were then analyzed by a phenomenographic method. It was revealed 5 categories of conceptions of learning science, including: leaning science as memorizing, leaning science as preparing for tests, leaning science as the increase of knowledge, leaning science as applying, and learning science as a part of certificate completion. It was found that student with conceptions of learning science as increasing knowledge were not only aim to further their education in a higher level, but also want to increase scientific knowledge for better understanding natural phenomena. For students who held conceptions of learning science as applying was found learning science to apply and solve problems in real life, this including take care of the elders and other family members. Students with conceptions of learning science as preparing for tests was found to learn science to pass the exam, and later be accepted by non-science school in the university. While, students with conceptions of learning science as memorize student was found learning to memorize the fact just to pass an exam in order to later on apply for a job as a factory worker with their family members. Finally, students with conceptions of learning science as a part of compulsory for receiving certificate was found uninterested about learning outcomes. By showing up in science class will lead to eventually receive certificate from high school. It was found lower conceptions of learning science of the students was involved non-challenging goal. The result suggested that conceptions of learning science of students in rural area are influenced by individual's goal setting and family expectation.

Conceptions of learning and approaches to learning science of students in general and gifted programs

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Previous research has established the relationship between students' conception of learning and approached to learning science. In this study, we aimed to explore students' conceptions of learning and approaches to learning science of students in general and gifted programs. The participants were 60 of grade 11th students of school district. Thirty students were studying in general program, and 29 were from gifted program. The data were collected using two well-developed questionnaires, Conceptions of Learning Science (COLS) and Approaches of Learning Science (ALS). Pearson's correlation coefficient was used for investigating the relationship between COLS and ALS. The results revealed that for general program 'Deep motive' was significantly correlated with 'Memorizing' ($r=0.53, p<0.01$), 'Increase of knowledge' ($r=0.60, p<0.01$), 'Applying' ($r=0.47, p<0.01$), and 'Understanding and seeing in a new way' ($r=0.64, p<0.01$). While 'Deep strategy' was found significantly correlated with 'Memorizing' ($r=0.53, p<0.01$), 'Increase of knowledge' ($r=0.63, p<0.01$), 'Applying' ($r=0.60, p<0.01$) and 'Understanding and seeing in a new way' ($r=0.64, p<0.01$). Whereas gifted program found 'Deep motive' was significantly correlated with 'Increase of knowledge' ($r=0.74, p<0.01$), Applying ($r=0.71, p<0.01$) and 'Understanding and seeing in a new way' ($r=0.70, p<0.01$). The 'Deep strategy' was also found significantly correlated with 'Increase of knowledge' ($r=0.57, p<0.01$), 'Applying' ($r=0.49, p<0.01$) and 'Understanding and seeing in a new way' ($r=0.60, p<0.01$). 'Surface motive' and 'Surface strategy' were found not correlated with any factors of the COLS for both general and gifted programs. Students in general program were more likely to adopt the 'Deep motive' and 'Deep strategy' approach to learning science than the 'Surface motive' and 'Surface strategies'. Additionally, students of general program had a tendency to adopt 'Memorizing' for 'Deep motive' and 'Deep strategy' as additional for learning science. While in gifted program, students were likely to adopt only the higher conceptions of learning for 'Deep motive' and 'Deep strategy' approach of learning science.

Investigating undergraduate engineering students' beliefs about the nature of knowledge and knowing in science: An Indian context

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India is the second-most populous country in the world and the world's sixth-largest economy¹. In India, more than 1 million students graduate in the engineering domain every year. However, according to the National Employability Report Engineers (2019)², 80% of the Indian engineers are unemployable because of the lack of higher-order and critical thinking skills. The development of higher-order and critical thinking skills is a complex process. One psychological factor that has been found to influence the development is the personal epistemic beliefs. Such beliefs are identified as in the highest level of cognition which regulates and guides cognitive and metacognitive activities (Kitchener, 1983). According to Hofer and Pintrich (1997), epistemic beliefs are defined as the personal beliefs about the nature of knowledge and knowing. Epistemic beliefs about the nature of knowledge concern certainty and structure of knowledge while beliefs about the nature of knowing address source of knowledge and justification for knowledge. In science education literature, it has been reported that students' epistemic beliefs in science affected their academic performance, learning strategies and scientific reasoning (e.g., Cano, 2005; Muis, 2007; Yang & Tsai, 2010, Yang, Bhagat, Cheng, 2019). In the study, an attempt was made to explore Indian Engineering students' epistemic beliefs in science. Students' epistemic beliefs were assessed by two questionnaires. One is Scientific Epistemic Beliefs (SEB) questionnaire constructed by Conley and others (2004). The other is the Justification Beliefs (JB) questionnaire developed by Bråten and colleagues (2013). SEB, which assesses epistemic beliefs about knowledge and knowing, provides an overview of an individual's epistemic cognition. Whereas, JB emphasizes epistemic beliefs in the justification dimension that is related more directly to thinking and reasoning. Participants of the investigation were 328 engineering students from two Indian universities located at urban and suburban areas with ages ranging from 20 to 23. Preliminary analysis showed that Indian Engineering students had developed dynamic epistemic beliefs. They seemed to hold more complicated epistemic beliefs about the nature of scientific knowledge but their beliefs about the nature of knowing in science were relatively less complicated. Significant correlations were found among different dimensions of epistemic beliefs in science. In particular, source and certainty beliefs in SEB associated more with justification by author in JB while justification beliefs in SEB correlated more with justification by multiple sources in JB. Between urban and rural students, the former demonstrated more complicated epistemic beliefs in science.

Conceptions of learning science among some Asian countries

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This study was to investigate the similarity and differences among Asian science learners' conceptions of learning. The learners from Taiwan, Singapore, Thailand, and Malaysia used the same questionnaire to assess their conceptions of science learning. By using Exploratory Factor Analysis (EFA), we found that the learners from different countries displayed different factor structure but showed a high degree of similarity. The results also showed that there were some significant differences in some factors of conceptions of learning across different countries.

Paper presentation

Day 2

Session B1

Teachers' beliefs

10:50-12:50 / Gymnasium 3F

Preservice teachers' beliefs about teaching knowledge

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Teachers' beliefs are preconceived notions held with personal conviction that influence planning, teaching practice and evaluation. While beliefs are likely to exist in interrelated networks in teachers' minds, their epistemic beliefs are particularly pertinent, due to the central role of knowledge in teachers' work. Teachers' beliefs about sources of knowledge may act as guides for their acquisition and engagement with different kinds of teaching knowledge, thereby shaping their professional practice and influencing students' lifelong learning. In a longitudinal mixed method study focusing on (preservice) teachers in two teacher education programs at a university college in southeast Norway, we assessed teachers' beliefs about useful sources of teaching knowledge and motivation to learn from different parts of the teacher education programs. Findings were further explored in semi-structured interviews that addressed beliefs about teaching and learning, sources of teaching knowledge and the relationship between theory and practice in teaching and teacher education. Beliefs about sources of knowledge were found to predict motivation to learn, and this seemed to relate to emerging patterns of participants' views of the relation between theory and practice in teaching. Implications for teacher education and learning are further discussed.

Exploring the Relationships among Mathematics teachers' Conceptions and Commitment in China

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This study investigated the relationships between mathematics teachers' conceptions of mathematics, conceptions of teaching and learning, and their commitment in the context of mainland China. A total of 847 mathematics teachers participated in a paper-based questionnaire survey. The results indicated that mathematics teachers' fragmented mathematics conceptions are positively associated with their traditional conceptions of teaching and learning while being negatively related to their constructive conceptions of teaching and learning. In contrast, teachers' cohesive mathematics conceptions are positively associated with both traditional and constructive conceptions of teaching and learning. Meanwhile, only constructive conceptions of teaching and learning are positively related to teacher commitment. These results imply that there is a need to develop cohesive mathematics conceptions among Chinese teachers to foster their commitment to constructive mathematics teaching.

Measuring teachers' epistemic beliefs and practices in two cultural contexts

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Educational reforms are challenging teachers worldwide. Introducing new pedagogical innovations and practices in education requires epistemic openness and flexibility of the teachers. In this study, we focus on identifying and assessing teachers' epistemic beliefs and how such beliefs are associated with practical ideas of pedagogy. Since there is accumulating evidence about teachers' epistemic cognition mediating their teaching practices and preferences (see i.e. Brownlee, Ferguson & Ryan, 2017), we developed a brief instrument, *Teacher Epistemic Questionnaire* (TEQ), for assessing beliefs that teachers hold about knowledge and knowing and how they would put such ideas in practice and tested it in two cultural contexts: Finland and Taiwan. TEQ consisted of 12 two-part Likert-type statements measuring four dimensions of epistemic cognition (Lonka et al., 2008; Vedenpää & Lonka, 2014). The participants were 228 subject matter teachers from Finland and 97 teachers from Taiwan. To explore the dimensional structure of the TEQ, we performed a set of Exploratory Factor Analysis (EFA). After identifying an acceptable EFA factor solution, we proceeded to construct a Confirmatory Factor Analysis (CFA). Finally, the correlations between beliefs and practices were looked at within each country. Two factors were confirmed: 1) reflective-collaborative theory and 2) knowledge transmission theory. Results also showed that there are strong correlations with epistemic beliefs and corresponding epistemic practices. In both Finnish and Taiwanese samples the correlation between beliefs and practices was stronger in the case of knowledge transmission theory than reflective-collaborative theory. In conclusion, the TEQ questionnaire is a reliable and valid tool that can capture some essential aspects of teachers' epistemic beliefs in two different cultures.

Finnish teachers' epistemic theories, new epistemic aims of their work and the manifestation of work engagement and burnout symptoms

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In changing knowledge society it is questioned, how educators meet new demands for learning and education. For instance, new policy documents concerning education tend to reflect a very sophisticated view on knowledge, learning and classroom practices. It is often taken for granted that teachers are ready to implement new requirements in their practice. We assume that some of these changes may feel overwhelming for teachers. In this study, we wanted to explore a potential misfit between the new demands of teachers' work and their resources to meet them. Our aim was to find out how teachers' epistemic beliefs and practices are related to their conformity for novel ideas of new curricula, and whether teachers' epistemic beliefs are related to their work engagement and symptoms of burnout. Participants (n = 228) were Finnish subject-matter teachers. For data analysis, we specified a CFA measurement model in which teachers' epistemic theories were represented by two latent factors: 1) reflective-collaborative theory and 2) knowledge transmission theory (Lammassaari, Lonka, Hietajärvi, Chen & Tsai, 2019 in process). To examine the relations between epistemic theories, work engagement and burnout symptoms, we plotted partial correlation network figures. Results showed a fit between reflective-collaborative epistemic theory and valuing the requirements of the new curriculum. The latter, in turn, had a negative relation with cynicism and work engagement but positive with inadequacy. Also a direct positive connection between reflective-collaborative epistemic theory and work engagement was found out. This study contributes to understanding of the role of teachers' epistemic theories and how is to identify frictions between new demands of teachers' work and their resources to meet them.

The role of science epistemic beliefs in predicting science teaching beliefs among Chinese pre-service kindergarten teachers

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For decades, researchers have documented a close link between Science Epistemic Beliefs (SEB) and science teaching, including both the science teaching practice and the beliefs. Based on the previous research background, we hypothesize that SEB could predict Science teaching beliefs (STB) among the pre-service kindergarten teachers. Altogether 987 pre-service teachers who were randomly sampled from a Teacher Education College in China were invited to complete the Scientific Epistemic Beliefs Scale developed by Lindfors et al. (2019) and the Teachers' Science Teaching Beliefs scale by Maier et al. (2013). The results show a significant difference in holding STB between the two levels of SEB holders ($p_s < .001$). Besides, Interest and Anxiety could jointly contribute to 14.22% of the variation in STB. In addition, a hierarchical regression analysis reveals that SEB could significantly predict 42.77% of variance in STB. Implications for both theory and practice should be discussed at the conference.

Thai pre-service physics teachers' conceptions of learning physics —How are they related to their preparing a lesson plan in a real physics class?

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Knowing how the pre-service physics teachers' conceptions of learning physics is necessary for the academic lecturers who have the responsibilities for producing physics teachers in high schools. Because of individual physics teachers' conceptions of learning physics directly effect to their teaching and preparing a lesson plan. Therefore, we would like to investigate their conceptions of learning physics and guide them to have more higher-level conceptions of learning physics. The major purpose of this study is to approach conceptions of learning in physics of 49 Thai pre-service physics teachers (1 first year student, 17 second year students, 15 third year students and 16 fifth year students), faculty of education, Chiang Mai university. The participants in this study must study major subjects, especially physics contents, in Department of Physics and Materials, Faculty of Science and the subjects which are concerned with teaching and preparing a lesson plan in Faculty of Education. For the fifth-year students, they must practice their physics teaching in high schools around Chiang Mai Province. The 31 questionnaires of the Conceptions of Learning Science (COLS) are applied and used to approach their conceptions of learning physics. Only 16 fifth year students, the individual lesson plans of each student they prepared and used in a real class are considered to find out how their conceptions of learning physics related to their lesson plan. The results indicated that, in general, the lower-level conceptions such as 'Memorizing' were more likely to positively, the higher-level conceptions of learning physics such as 'Seeing in a new way' were more likely to be positively correlated with the deep approaches to learning physics. Moreover, this study revealed that the conceptions the 16 fifth year students used to prepare their teaching physics in a real class are associated with their conception of learning physics especially in terms of "Calculating and Practicing".

Paper presentation

Day 2

Session B2

Epistemological among science learners

15:10-17:10 / Education Building 3F Conference Room I

Science academic hardiness and leaning achievement of urban Thai 10th graders

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Academic hardiness is a personal characteristic that provides the courage and motivates for students to perform hard work in order to achieve academic goals. Research findings have demonstrated that academic hardiness involves in student academic achievement. It helps cope with stress and anxiety from school life events. The purposes of this study were to 1) examine correlation between three components (3Cs) of science academic hardiness (SAH), namely 'Commitment', 'Control' and "Challenge", and 2) to investigate the relationship between SAH and learning achievement. A well-validate questionnaire instrument of SAH was translated into Thai. It was used as a tool to collect data from 60 of 10th graders who were studying in science program. Partial least squares structural equation model (PLS-SEM) technique in Smart PLS 3.0 was used to test the proposed model and to study the relationship between students' hardiness and their learning achievement. Results of this study revealed that 'Commitment' was found to significantly positive associated with learning achievement ($p>0.05$). Moreover, 'Commitment' was strongly positive associated with 'Control' ($p<0.05$) and 'Challenge' ($p<0.05$). While 'Challenge' was strongly negative associated with learning achievement ($p<0.05$). The results preliminarily indicated that 'Commitment' of SAH play an important role in promoting learning achievement. While facing with an unfamiliar and challenging task of leaning decrease their learning achievement. Classroom culture and school's context related to hardiness were discussed.

Scientific epistemological beliefs and academic performance of high school biology students

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The science epistemological beliefs of student have important role in learning science as it reflects to how students perceive learning, and their learning outcome as a consequence. The present study aimed to investigate the relationship between scientific epistemological beliefs (SEBs) and academic performance. The total of 76 of 10th graders, who were studying in science and mathematics program, were participated in this study. A well-validated SEB questionnaire was translated and used as a tool to collect data. The questionnaire was consisted of four dimensions of scientific knowledge and knowing; 'Source', 'Certainty', 'Development' and 'Justification'. Students' academic performance (GPA) of science was obtained from the latest semester. Partial least squares structural equation model (PLS-SEM) technique in Smart PLS 3.0 was used to test the proposed model and to study the relationship between students' SEBs and their academic performance. Four dimensions of SEBs showed relatively good reliability in internal consistency. Path analysis indicated some significant relations between SEBs and academic performance. It revealed that 'Source', 'Certainty' and 'Justification' of SEBs were found to negatively correlated with academic performance. While only beliefs in 'Development' of scientific knowledge was positively correlated with academic performance. Moreover, it was found that beliefs in 'Certainty', 'Development' and 'Justification' knowledge were positively correlated with 'Source' of scientific knowledge. Teaching and learning science practices, this including classroom culture, are used to further discuss.

Culture and learning science: Exploring secondary school student's epistemological beliefs in northeast Thailand

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Science's implementation in the East, as it is a product of Western culture, could be expected to be challenging given the distinct cultural differences between West and East. Science education researchers have investigated how students learn in these and other different cultural contexts. Within Asia, the Thai culture is known to be particularly distinct. Yet, how this may influence teaching and learning science has not been investigated. This study was carried out in Thailand to better understand how culture affects students' epistemological beliefs. The aims were to 1) explore how conceptions of learning (COLS) and science learning self-efficacy (SLSE) change from junior high and high school, and 2) the relationships between COLS and SLSE. Participants of this study included students from 3 different administrative school divisions: provincial, district and sub-district. Translated questionnaire instruments were used to collect data from 328 junior high schools and 369 high school students. Multivariate analysis of covariance and regression analysis were used to analyze to compare COLS and SLSE between junior high and high school students. The relationship between COLS and SLSE were analyzed using confirmatory factor analysis and structural equation modeling. The results suggest a transition in epistemological beliefs. Also, different of COLS and SLSE between schools in different administrative areas also were revealed. In general, it was found lower COLS is significantly related to lower SLSE, while higher COLS is related to higher SLSE. Moreover, differences in epistemological beliefs detected between urban and rural schools and how they may reflect their contrasting socio-cultural contexts are discussed.

An exploratory study on Taiwanese high school students' beliefs about knowing and learning engagement in science

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Although researchers have contended that epistemic cognition is one of the influential factors in how an individual chooses to engage in learning process, nearly no empirical evidence has supported this claim in the field of science education. Guided by the research question “*What is the role of beliefs about knowing in Taiwanese high school students' learning engagement in science?*” this study aims to provide preliminary evidence on the relations between beliefs about knowing and learning engagement in science. In this study, 280 students from six senior high schools across Taiwan were selected to answer the survey items with respect to beliefs about knowing and learning engagement in science. The results indicated that, first, the *Purpose of knowing* dimension is a positively significant predictor across all the five SLEI dimensions, including *Cognitive engagement*, *Behavioral engagement*, *Agentic engagement*, *Emotional engagement*, and *Social engagement*. Second, the predictive effects of the *Justification for knowing* were only found in *Cognitive engagement*, *Emotional engagement*, and *Social engagement*.

The relationship between scientific epistemic beliefs and conception of learning science and academic performance in Thailand university students

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This study was to investigate students' scientific epistemic beliefs and their conception of learning science and examined correlation between Thai ungraduated students' scientific epistemic beliefs, conception of learning science and academic performance (Grade Point Average). A total of 294 ungraduated students who were enrolled in General physics course in the first semester of 2018 academic year. Collecting the data by using two instruments, Scientific Epistemology Beliefs Questionnaire (Conley, Pintrich, Vekiri, and Harrion, 2004.), and Conception of Learning Science questionnaire (Lee, Johanson, & Tsai, 2008). The findings revealed students tend to hold a complex beliefs in source, development, and justification. However, they still had a naïve beliefs in certainty, which thinking about scientific knowledge is certain instead tentative and can change overtime. For the COLS, the tendency reveal that students have a constructive conception in increasing one' knowledge, applying and understanding and seeing in a new way. The findings of correlation shown that source was positively related to certainty at significant level (0.05), but it shown negatively related to development at a significant level (0.01). In addition, development strongly positive related to justification (0.05). It clearly present positively relation a significant level (0.05) in two groups. The source and certainty were associated with reproductive factors, memorizing, testing and calculating and practicing. The second complex dimensions of development and justification were associated with constructive factors of increasing one's knowledge, applying, understanding and seeing in a new ways and also one of reproductive factor such calculating and practicing. Moreover, then comparing the academic performance in science subject as Grade Point Average (GPA) with SEBs and COLS found that GPA was negatively related to source of SEBs (0.05) and memorizing of COLS (0.01).

Exploring middle school children's science epistemic beliefs: Implications for measurement

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There is an urgent need to increase students' science achievements given their relation to economic growth and abilities to solve complex social and environmental problems (OECD, 2016). However, many Australian middle school students are struggling with the demands of science specific literacy that involve comprehension of a complex range of texts (Duke et al., 2011). Science epistemic beliefs (SEBs) have been shown to influence how students make meaning of science concepts and texts (Bråten et al., 2017). This study explored Australian middle school students' SEBs. Forty-five Year 8 (12-14 years) students from one rural and one metropolitan school responded to open-ended and forced-choice questions about two conflicting scenarios that described how frogs became deformed (drawing on Barzilai & Weinstock's (2015) ETA survey items). Our interview protocol adapted 10 of the 11 items in the ETA. Four items were asked as open-ended questions, while the remaining six were forced-choice. All responses were coded as absolutist, multiplist or evaluativist in nature. Our preliminary findings revealed that students held a range of SEBs however responses to the open-ended questions reflected mostly absolutist and multiplist beliefs. The responses to the forced-choice questions were more evaluativist in nature. We also noticed more absolutist responses in some of the forced-choice responses. These findings suggest that forced-choice questions may scaffold students' responses, enabling them to respond in ways that reflect more evaluativist SEBs. It may be important to consider including multiple response types in surveys and interviews to ensure that the full range of students SEBs are captured.

Paper presentation

Day 2

Session B3

Trend of epistemic development

17:20-18:00 / Education Building 3F Conference Room I

A literature survey of epistemic research (2000-2018): International publication patterns and research trends

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This paper aims to provide a bibliometric approach to extract out the most valuable knowledge of longitudinal epistemic publications with two main research purposes. First, to highlight countries with the highest productivity in the epistemic research. Second, to identify some critical keywords based on the keyword analysis. Two analytic methods were used to decompose the intellectual structure of epistemic research. While the bibliometric analysis was treated as the initial step to provide a comprehensive understanding of the international publication patterns in epistemic literature, the keyword analysis was used to extract the most critical domain-specific attributes to highlight the research trends in the epistemic research. Two main results were concluded: First of all, we have identified the top six countries contributed more than 100 articles. Researchers from the USA (953), UK (335), Canada (133), and Taiwan (124) published epistemic articles every year in both decades (2000-2018), while researchers from Australia (200) and Germany (108) focused on the recent decade (2010-2018). Second, from the amount of 5,313 collected wordings, we have identified a total of 20 keywords. Among them, 10 keywords are most commonly used in both research decades (i.e., Students, Epistemological, Learning, Knowledge, Science, Teaching, Epistemic, Teachers, Development, and Belief). The other 10 keywords, however, only appear in recent epistemic literature (i.e., Writers, Energy, Literacies, Enactment, Thematic, Environmental education, Teachers epistemic, PISA, Aesthetic, and Artefacts). Further discussions are provided.

University students' epistemic profiles and their relations to conceptions of learning and academic progress: A longitudinal study

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We examined university students' epistemic profiles and their relations to conceptions of learning, age, gender, discipline and grades. We measured epistemic beliefs: Reflective learning, collaborative knowledge-building, valuing metacognition, certain knowledge and practical value. The participants were 1515 students from five faculties who completed questionnaires about epistemic beliefs (Lonka et al., 2008), including a subgroup (n=709) who also completed a questionnaire that included conceptions of learning (Vermunt, 1998). We analyzed structural validity using confirmatory factor analysis (CFA). We examined epistemic profiles using latent profile analysis (LPA). Three-class LPA solution fit the data: *fact-oriented* (25%), *collaborative-reflective* (26%), and *practical fact-oriented* (49%) groups. Within the subgroup, we compared the conceptions of learning across the profiles (ANOVA): Intake, construction and use of knowledge. We compared age, discipline and grades across the profiles. The profiles' conceptions of learning varied: The *collaborative-reflective* group scored high in "construction of knowledge." Its members were more likely to be female, teacher- and mature students, and they had the highest academic achievement. The *fact-oriented* group (mostly engineering/science students) scored highest in "intake of knowledge." The *practical fact-oriented* group scored highest in "use of knowledge": During the second year, their academic achievement improved. In sum, the epistemic theories were closely related to conceptions of learning and were also associated with academic achievement. Longitudinal analyses about university students' epistemic change over the first three years of studies are in progress. Besides the longitudinal self-reported data, register based graduation data from the 5th study year will be analyzed in relation to epistemic change.

Paper presentation

Day 3

Session C1

Design beliefs and thinking

11:30-12:10 / General Building 509

Exploring the relationships between pre-service teacher's design behaviours and their design belief

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This study examines how pre-service teacher's design-oriented knowledge building activities affected their personal epistemology and belief about technology-integrated design knowledge. The data sources included (1) pre-service teacher design behaviours in a knowledge building environment; and (2) the pre-survey and post-survey results based on two questionnaires, namely technology-integrated design knowledge (TIDK) and design belief of teacher (DBT). From the sequential analysis, it found that their online design behaviours had significant changes, while the quantitative results showed a slightly improved epistemology and belief as reflected in the TIDK and DBT ($t=13.692, p<.05$; $t=9.647, p<.05$). Overall, pre-service teachers design activities under the guidance of a technology-assisted knowledge building environment seemed to enhance their design knowledge and beliefs for effective teaching.

Conceptualizing design thinking as a knowledge creation model in teaching context

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Design thinking is receiving increasing attention in current literature especially in the TPACK research (e.g., Tsai & Chai, 2012). Evidence from different teaching and learning contexts has supported that involving in design thinking process contributes to teachers' knowledge construction (e.g., Koh & Chai, 2016). However, the conception of teachers' design thinking remains somewhat vague and the relationship between teachers' design thinking and knowledge construction needs to be further understood. In this paper, design thinking in teaching context is conceptualized in a manner that is contextualized to teacher individuals' situation with unobservable and observable actions taken by the teacher. From this point of view, the relationship between teachers' design thinking and knowledge construction could possibly lie in that teachers' teaching knowledge is spontaneously developed as they engage in the abovementioned design thinking processes. Further research can be conducted through qualitative approach to identifying teachers' design thinking experience to provide empirical evidence to such processes. Quantitative studies can also be employed to test the relationship between teachers' engagement in design thinking and teaching knowledge growth through structural equation modeling approach with proper measurement developed first.

Paper presentation

Day 3

Session C2

Epistemology in technology-supported learning environment (II)

13:40-14:40 / General Building 509

**The relationship between epistemic emotions and learning achievements in massive open
online course**

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Empirical studies on epistemic emotions and learning achievements of MOOCs has brought a critical need for understanding how epistemic emotions potentially affect learning achievements. Therefore, this study identified the relationship between epistemic emotions and learning achievements in MOOCs. Through learning analytics from multiple data of 1847 learners in MOOCs, six epistemic emotions (i.e., enjoyment, confusion, boredom, neutral, anxiety, and social-emotion) were recognized in terms of high- and low-learning achievements. The results from this study revealed that the frequencies of enjoyment epistemic emotions and social-emotions expressed by both groups are considerably close, whereas the low achievers experienced more anxiety and boredom epistemic emotions. Of particular interest, high achievers went through more confusion epistemic emotions than low achievers during learning process, which were positively related with high-learning achievements. These results suggested that confusion epistemic emotions might be a productive aspect of learning process. Moreover, the implications for instructor practice were discussed.

A case study of changes of fourth-grade students' epistemological beliefs in science learning leveraged by a mobile learning platform

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Despite increased efforts being invested in mobile technology-enhanced science learning in primary education, few studies have investigated into the influence of mobile technology intervention on learners' epistemological beliefs in science learning. This one-year case study aims to examine how primary learners' epistemological beliefs in science learning changed after they were engaged in collaborative science inquiry leveraged by a mobile learning platform embedded with a collaborative inquiry-based learning model. Participants were two classes of fourth-grade students in Hong Kong. Data collection involved logged data of learners' collaborative inquiry-based learning on the mobile learning platform, questionnaire data of epistemological beliefs in four dimensions of science source, certainty, development and justification (Conley, Pintrich, Vekiri, & Harrison, 2004, [*Contemporary educational psychology*, 29(2), 186-204.]) and focus group interviews. Descriptive data analysis was used to analyze the questionnaire data. Examples of groups' artifacts were presented as evidence of students' science epistemologies. Content analysis was employed to analyze the interview data, taking the four dimensions of epistemological beliefs as the coding scheme. The research results shows that students' epistemological beliefs were changed mediated by the mobile technology learning platform embedded with the collaborative inquiry-based learning model, especially in terms of science development and justification. It is no denying that the results of this case study could not be generalized. Empirical studies need to be conducted to investigate the effectiveness of the mobile learning platform for collaborative science inquiry in order to scale up the pedagogical practices in a mobile learning environment in primary science education.

The Effects of the Cloud-Based Epistemic Prompting on University Students' Multimodal Multiple-Document Reading

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This study was designed to advance our understanding of the theories behind and application of multiple-document reading encompassing both YouTube videos and written texts on webpages among university students. The effect of digital technologies including digital epistemic prompting and note-taking was examined on students' multimodal multiple-document reading, considering their justification for knowing based on different sources of information. Students were randomly assigned to an experimental group with browser-embedded epistemic-prompts in addition to a note-taking function or to a control group with the note-taking function only. Both groups of students were required to read three assigned texts and to conduct additional online searches about the topic if needed. The study results showed that the majority of students relied on the YouTube video as the only external source for multiple document reading. Moreover, students rated the YouTube video as being more reliable than the newspaper article, pointing to the importance of teaching students how to evaluate the source and quality of YouTube videos for multimodal multiple document reading. Most importantly, the result suggested epistemic prompting can help students create a coherent mental representation of information from diverse sources beyond the effect of personal justification and multiple justification. Implications of the study findings were discussed to inform instructional supports for students' online multimodal multiple document reading.

第三屆個人知識觀與學習國際研討會 會議手冊

【會議日期】2019年11月28日、11月29日、11月30日

【會議地點】國立臺灣師範大學體育館三樓金牌講堂、
教育學院三樓第一會議室、綜合大樓509

【主辦單位】 國立臺灣師範大學 學習科學跨國頂尖研究中心
臺灣數位學習與內容學會
國立臺灣師範大學 學習資訊專業學院

【贊助單位】 科技部
教育部高等教育深耕計畫
國立臺灣師範大學



TELDOCA

