# Personal Epistemology and Learning (PEL) Conference Program Book

National Taiwan University of Science and Technology

Taipei, Taiwan, 16- 17, December, 2009.

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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," 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, and the cultural impacts on the development of personal epistemology have received growing interests among researchers. It is hoped that international practitioners contribute papers for presentation at PEL conference to share their research findings and best practices, as well as exchange updated views of recent development in the field.

## Conference Chair:

**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. 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 is currently a Chair Professor at the Graduate School of Technological and Vocational Education, National Taiwan University of Science and Technology, Taipei, Taiwan. Since July 2009, he has been appointed as the Co-Editor of *Computers & Education* (published by Elsevier, ranked as the sixth among more than 100 educational journals indexed in SSCI by 2008 impact factor values). His research interests deal largely with constructivism, epistemological beliefs, and Internet-based instruction related to science education. In the last five years, he has published more than 60 papers in English-based international journals. His research work has been published in *Learning and Instruction, Science Education, Journal of Research in Science Teaching, International Journal of Science Education, Instructional Science, Teaching & Teacher Education, Computers & Education, Journal of Engineering Education* and other educational journals.
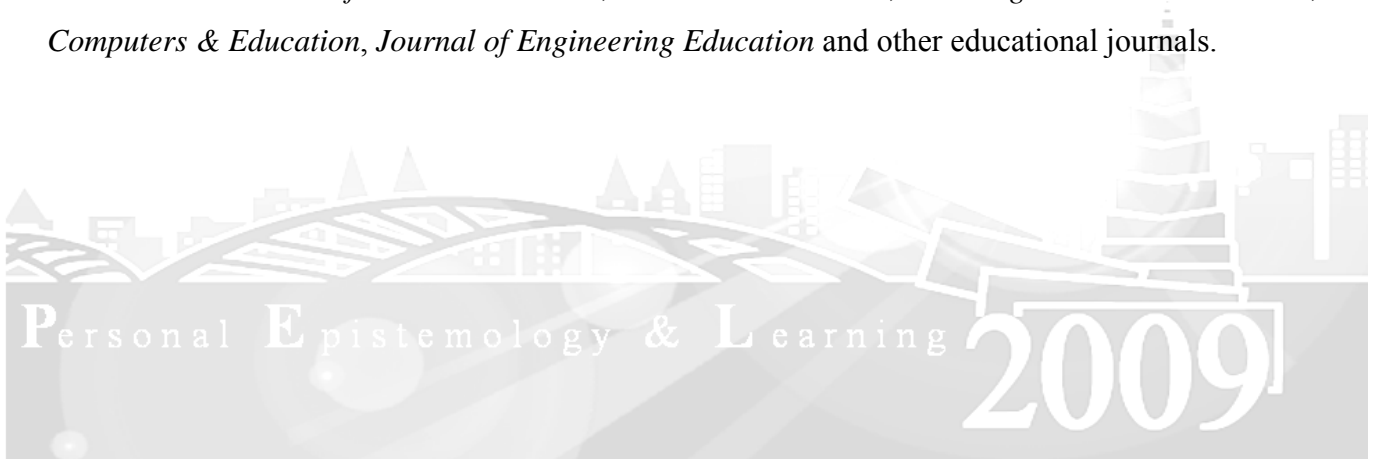
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Presider: Prof. Chin-Chung Tsai
National Taiwan University of Science and Technology, Taiwan

Prof. Barbara K. Hofer
Prof. Lucia Mason
Prof. Elmar Stahl
Prof. Chin-Chung Tsai

**Program session format**

In a paper session, the presider introduces the presenters and monitors the time used for each presentation. All papers will be allotted 15 minutes for presentation, followed by approximately 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

**Keynote Speaker**

Prof. Barbara K. Hofer (Department of Psychology, Middlebury College, USA)

**Barbara K. Hofer** is a Professor in the Department of Psychology at Middlebury College. She received her Ph.D. from the University of Michigan from the Combined Program in Education and Psychology, with a certificate in Culture and Cognition. She is the recipient of the Review of Research Award from the American Educational Research Association (with Paul Pintrich) and the McKeachie Early Career Teaching Award from the American Psychological Association, and is the outgoing Secretary of APA Division 15, Educational Psychology. She has published several dozen articles and book chapters, and co-edited the book Personal Epistemology: The Psychology of Beliefs about Knowledge and Knowing (published by Erlbaum). Her primary research focuses on the development of personal epistemology and how this interacts with learning strategies, motivation, cognition, and academic performance; her research is currently funded by a four-year National Science Foundation grant from the Developmental and Learning Sciences area. She has also continued to work on cross-cultural studies and was a Faculty Fellow at Doshisha University in Kyoto, Japan, in 2002 and 2008. Her research work has been published in *Review of Educational Research, American Educational Research Journal, Educational Psychologist, Contemporary Educational Psychology, Educational Psychology Review* and some other educational journals.

# Personal epistemology: An integrative approach to research

Barbara K. Hofer

Department of Psychology, Middlebury College

Individual conceptions of knowledge and knowing have been shown to be intricately related to learning and education. What students think knowledge is and how knowing occurs, how knowledge is justified and where it resides, all have significant implications for how students approach learning and how they perceive educational experiences. In reciprocal fashion, educational experiences also influence epistemological development. In this talk I will provide a short overview of paradigmatic approaches to understanding personal epistemology, illustrated with a set of studies I have conducted in order to investigate epistemic understanding and how it is related to cognitive processes, instantiated in pedagogical practices, and activated metacognitively. I will review methodological approaches employed in my research, including surveys, classroom observations, interviews, and think-aloud protocols, and will talk about the value of a mixed-method approach to understanding personal epistemology and learning. Primary focus will be on the preliminary results of an ongoing study of epistemological development in adolescence from sixth grade through the first year post-high school, funded by the U.S. National Science Foundation's division of Developmental and Learning Sciences. I will conclude with a rationale for theoretical integration of existing models of personal epistemology, implications for education, and suggestions for future research, as well as suggestions for addressing epistemology from a cultural perspective.

**Keynote Speaker**

Prof. Elmar Stahl (University of Education, Freiburg, Germany)

**Elmar Stahl** is a full professor at the University of Education, in Freiburg, Germany. He is the head of the Institute of Media in Education since 2007. He received a diploma in Psychology with a thesis about binocular rivalry (visual perception) in 1995. In 2001 he received his Ph.D. with a thesis about knowledge acquisition and learning processes by writing hypertexts. In 2006 he received his habilitation (= a kind of second PhD Thesis, common in Germany to qualify for a tenure position as a full professor). His current research interests include research and teaching on video-based learning, epistemological beliefs, learning by hypermedia construction and help seeking within interactive learning environments. He is (together with Prof. Dr. Rainer Bromme, University of Muenster, Germany) the founder and head of the European network of Research on Epistemological Beliefs, sponsored by the DFG (German Research Foundation). His research work has been published in *Review of Educational Research, Learning and Instruction, Computers & Education, Computers in Human Behavior* and some other educational journals.

# The generative nature of epistemological judgments

Elmar Stahl

University of Education, Freiburg

In the early stages of research on epistemological beliefs, most researchers have conceived this construct as a general and rather stable way of thinking about knowing and knowledge, developing from so called 'naive' towards 'sophisticated' epistemologies. Nowadays we have growing empirical evidence that epistemological beliefs may be less coherent, more discipline-related and especially more context-dependent than it was assumed at the beginning of research. This view is in line with several approaches in cognitive psychology that were introduced to take into account the high flexibility and context-dependency of our cognitive system, like the MOP (e.g. Schank, 1982), the CI – model (e.g. Kintsch, 1998), the view of concepts (e.g. Barsalou, 1987), the COPES-model (Winne & Hadwin, 1998). Epistemological beliefs – as part of the cognitive system – might therefore be influenced by comparable processes of context-dependent activation.

From this view 'sophisticated epistemological beliefs' can be defined as beliefs which allow for context-sensitive judgments about knowledge claims (see Bromme, Kienhues & Stahl, 2008). Thus sophisticated beliefs enable flexibility with regard to a specific discipline and a specific context. If this might be true, then context-sensitive epistemological judgments about knowledge claims can not be done by "just" activating some general epistemological beliefs. Instead epistemological judgments might be generated from a learner within a context by using combinations of different kinds of sources like topic-related knowledge, (discipline-specific) epistemological beliefs, ontological knowledge, and information about the context. These sources can (or cannot) be activated within different contexts and can complement or compensate each other to attain an epistemological judgment.

In my talk I am going to give some (indirect) empirical evidence for this idea, presenting data from our own research on the effects of epistemological beliefs in learning scenarios with hypermedia, interactive learning environments and films. Then I am going to present possible (re-)interpretations of some problems that we face in research on epistemological beliefs, e.g. problems with unstable instruments, problems to replicate findings, or the critic of Chandler, Hallett & Sokol (2002) that all assumed stages of developmental models with a linear step-by-step development of epistemological beliefs can be found in all age levels. In the last part I am going to present a different idea on research on epistemological beliefs derived from research on the visual system (Grossberg, 1987a,b), that might help to give new insights into the context-dependency and the (claimed) generative nature of epistemological judgments.

**Keynote Speaker**

Prof. Lucia Mason (Educational Psychology, the University of Padua, Italy)

**Lucia Mason** is a Professor of Educational Psychology at the University of Padua, Italy, and head of the doctoral program in Developmental Psychology and Socialization Processes. She is associate editor of *Educational Research Review* and member of the editorial boards of several journals: *Cognition and Instruction*, *Contemporary Educational Psychology*, *Instructional Science*, *Journal of Experimental Education*, *Metacognition and Learning*, and *European Psychologist*. She served as chair of the 10th conference of the European Association for Research on Learning and Instruction (EARLI). Her main research interest is conceptual change. She has carried out studies on analogical reasoning, argumentation in group discussions, and writing to learn as tools for knowledge revision. Her current research interest also regards students' epistemic beliefs and their role in learning processes, in particular in conceptual change. Her last studies are focused on the activation of epistemic beliefs during online information searching and the effect on Web-based learning. She has published many articles in international journals, several chapters in international volumes, as well as some national volumes. She has also co-edited two international volumes. In 2003 she was the recipient of the EARLI Outstanding Publication. Her research work has been published in *Learning and Instruction, Instructional Science, Journal of Educational Psychology, Educational Psychologist, Contemporary Educational Psychology* and some other educational journals.

# Epistemic beliefs in action: Evaluating and learning information on the Web

Lucia Mason

Educational Psychology, the University of Padua

This presentation aims at discussing students' epistemic beliefs in the context of online searching for information about controversial topics. The World Wide Web is now one of the most used tools for solving information problems for academic assignments. To effectively locate, identify, and use Internet-based material is not only a question of formulating efficient search queries and applying appropriate reading strategies (Brand-Gruwel, Wopereis, & Vermetten, 2005; Kuiper, Volman, & Terwel, 2005), it is also a question of being able to follow up only pertinent, accurate, and supported information from credible sources (Hofer, 2004; Mason & Boldrin, 2008; Tsai, 2004, 2008; Tu, Shih, & Tsai, 2008). The task of controlling the veracity, accuracy, and relevance of information, traditionally carried out by editors and publication companies, is now transferred to the students themselves, and it demands much in terms of critical evaluation and learning of multiple documents (Bråten, 2008). Most of the concerns raised by teachers and educators - who complain the lack of students' ability to orient themselves on the Web - are not questions of technology but rather questions of beliefs about the nature of knowledge and knowing (Hofer & Pintrich, 2002).

Taking into account the different lines of research on Internet searching and epistemic beliefs (Hofer, 2000; Kuhn, 2000), three studies have been carried out. The first involved middle school students who were interviewed after a search. The second involved high school students who thought aloud during a Web search. The third involved university students who read web pages while the allocation of their visual attention was measured using an eye tracker. Main findings will show different patterns of solicited epistemic reflection about the accessed information (first study), as well as spontaneous judgments about the credibility of a web source and the veracity of its content (first study). In addition, eye-tracking data will indicate that visual attention is allocated according to the authoritativeness of a website (third study). Furthermore, students' epistemic reflections and their Web-based learning will be analyzed in relation to individual characteristics, such as prior knowledge, study approach, domain-specific epistemic beliefs about science, argumentative reasoning skills, and need for cognition. Educational implications on the importance of multiple-document literacy skills (Bråten, Strømsø, & Britt, 2008; Goldman, 2004; Rouet, 2006) will conclude the presentation to highlight that students must be taught to become competent consumers of information.

# Paper presentation
**Day 1**
**Session A1 / 1040- 1230**
**IB201**

# Epistemological differences between science and technology: Evidences from argument analysis

Ruey-Yun Horng, Po-Hui Lu and Chia-Ning Liao

Department of Industrial Engineering and Management

National Chiao Tung University, Taiwan

Although science and technology have common roots in what constitute valid knowledge and the methods for acquiring valid and reliable knowledge, people may have different beliefs about what constitute valid knowledge in science and in technology. The purpose of this study was to compare the similarities and the differences in people's epistemology between science and technology by argument analysis. Argument analysis can be used to study people's personal epistemology because it requires people to make an explicit claim regarding their beliefs to an issue and explain explicitly and forcefully what are the basis for their claim. Sixty-nine university students were asked to take a position and argue for their own position after reading, in random order, a science text and a technology text. Participants' arguments were analyzed according to argument structure (number of supporting arguments, counterarguments, and refutations), argument content (explanation, evidence, or alternative claims), and methods of refutation (refutation by explanation, evidence, logical coherence, or alternative accounts). Results showed that participants tended to give more supporting arguments for technological issue than for scientific issue.

Moreover, they were less able to refute counterarguments raised against the technological issue than those against the scientific issue. When arguing for or against a technological issue, participants relied mostly on explanations and reasons, whereas they focused more on evidences and alternative accounts when arguing for or against a scientific issue. It suggests that people are less skeptical of what was proposed in the technological arguments. In contrast, people would check the validity of the scientific findings by their experiences. These findings suggest that people may hold different epistemological beliefs about what constitute valid knowledge in science and in technology. The explanations they raised to support or discount a technological proposal are often related to the functions (effects) of the technological system. In contrast, people tend to raise alternative causes for the observed phenomena in the scientific findings and challenge the strength of the evidence provided by the study. Epistemological differences between science and technology within an individual suggest that people's personal epistemology may vary across domains due to their personal experiences and education in the domain.

# The explorations of the elementary school students' conceptions of learning: A drawing test analysis

Hung-Yuan Wang

Graduate Institute of Engineering

National Taiwan University of Science and Technology, Taiwan

The purpose of this study was to investigate elementary school students' conceptions of learning by using a drawing method. The research data were gathered from 102 elementary school students' drawings about their conceptions of learning. A coding framework was developed as an analytic tool. The results showed some stereotypes of Taiwan elementary school students' conceptions of learning. First, their conceptions of learning seemed to be greatly related to a normal classroom setting. Most of these students' conceptualized learning mainly focused on describing the learning context and learning activities involved. Second, it was also found that students held some negative conceptions about learning. Furthermore, students' conceptions of learning were developed and changed with their ages and learning experiences. Through this study, younger students' conceptions of learning were investigated. And the drawing test used in this study might provide educators an opportunity to investigate the students' conceptions of learning as a new approach.

# How Chinese high school students construct their meanings of nature of science: From the discursive resources perspective

Feng Deng, Ching-Sing Chai, and Der-Thanq Chen

Learning Sciences and Technologies, National Institute of Education, Singapore

Views of the nature of science (NOS) have been suggested as a vital component of scientific literacy. Relevant researchers primarily used survey and/or interviews to examine whether an individual student *have* an adequate understanding of NOS. These researchers seemed to treat "views of NOS" as storable and relatively stable theories possessed by individuals. They may assume that students' written and oral responses (i.e., discourse) can *neutrally represent* their theories about NOS. However, this study assumed that views, beliefs, and epistemologies are discursive achievements dependent largely on the context. We treat language as a cultural tool for individuals to co-construct their meanings. Methodologically, students' talk was regarded as a topic rather than as "a resource" or "a product of mental entities". We thus examined what sorts of discursive resources (i.e., interpretative repertoires, IR) students may deploy to buttress their claims about NOS. We also investigated how students construct their meanings of NOS with their peers by using various IR. Four Chinese 10th grade students (two male, two female) were invited to discuss four NOS-related statements with one another. They were asked to express their opinions and rationales. They were encouraged to supplement and/or critique their peers' ideas if possible. The whole process of discussion was audio-taped and transcribed. Verbatim transcriptions of discussion, students' individual reflective journals, and the researcher's field notes jointly constitute the main data source of this study. Eleven types of IR have been recognized in the study. Regarding students' use of interpretative repertoires, several patterns have been identified: (a) some students tended to frequently use certain discursive resources; (b) some students were able to interchangeably use various resources; (c) students tended to support and/or critique others' viewpoints by drawing on various resources; (d) multiple use of discursive resources may allow the generation of meaning potentials for students to construct and share their meanings of NOS; (e) a few resources were found to be frequently used regardless of the NOS-statements discussed. We suggest that science teachers should engage their students in well-designed classroom discussion on NOS. Students' views of NOS can be interpreted in terms of the more varied and deeper discourse resources they utilized to support and critique claims about NOS. Future studies can investigate how students and teachers employ discursive resources to co-construct meanings of NOS within varied learning contexts.

# Technical college students' learning experience and motivation about school science and life science

Hsin-Chung Ting

Chia Nan University of Pharmacy & Science, Taiwan

Based on PISA 2006 reports, Taiwan junior high school students had lower self-concepts in science about academic achievements and school experience than mean performance of OECD countries. Most Taiwan technical college students were from the vocational school, and these students made the lower learning achievement in natural science during their junior high school. When these students entered the technical college education, how they to face professional science curriculum and to make a choice of the future occupation is to deserve to pay much attention. The research purpose was to investigate the technical college students' learning interest concerning general chemistry and life chemistry, and to detect whether the students' learning interest in life chemistry were correlated with their college department and the extending occupation. Two author-constructed, semi-structured questionnaires "scientific learning experiences in middle school" and "scientific learning interest about general chemistry and life chemistry" were developed to interview the college students' thoughts. Research tool's validity was expert validity. Sixty junior undergraduates, including 20 food science majors, 20 cosmetic science majors and 20 environmental science majors, from two technical colleges in the central and southern Taiwan participated in the questionnaires and interviews. Findings revealed that most students were more interested in the life chemistry than school natural science and general chemistry, but they were interested in school scientific experiments. They were uninterested in general chemistry, because of lower learning achievement in natural science during their junior high school, more calculations of the chemical reaction, and more abstract conceptions and symbols. However, they are interested in life chemistry correlated with their college department and extending occupation. Most students said they would engage in the extending occupation related to their college department in the future. Maybe we would transform their learning interest in life chemistry into general chemistry and professional science curriculum, and encourage their intrinsic motivation, through the suitable curriculum design approached to industrial requirements.

# Personal and social epistemologies of information credibility

Feng-Ming Lin

*Graduate Institute of Engineering, National Taiwan University of Science and Technology,
Taiwan

In this study, we aimed to investigate the relationship between personal and social epistemologies from the angle of information credibility. Twenty graduate students were first interviewed and then three dimensions were constructed based on their responses to analyze how they assess the online information credibility. These three dimensions are (1) the user's strategy, (2) the information quality, (3) the conception of internet. All of dimensions include *individual* and *collective* approaches. As the result, we propose that personal epistemology is related to social epistemology.

# Paper presentation
**Day 1**
**Session B1 / 1040- 1230**
**IB202**

# 知識/認識觀、目標導向與認知投入徑路模式之檢驗

劉佩雲 [1*]　　　　　　　　李秀娟 [2]

[1*]玄奘大學成人教育與人力發展學系　　　[2]苗栗縣泰興國小教師

　　知識/認識觀（personal epistemology）是對知識本質（the nature of knowledge）或知曉（knowing）本質與過程的看法（Hofer & Pintrich, 1997）。相關研究發現知識/認識觀會透過目標導向間接影響認知投入策略使用（Dahl, Bals, & Turi, 2005; Kizilgunes, Tekkaya 與 Sungur, 2009; Schreiber & Shinn, 2003；施淑慎，2004）。本研究探討 323 名國中小學生所持知識/認識觀與目標導向對認知投入之徑路關係。研究工具為「知識/認識觀量表」（陳萩卿，2005）與自編之「目標導向量表」及「認知投入量表」。結果顯示所建構理論模式整體品質尚佳，能用來解釋實際的觀察資料。經以 SEM 進行中介變項檢定，發現變項間之徑路關係皆符合 Baron 與 Kenny（1986）的三個條件。而知識/認識觀對淺層投入（β= .18, *p*<.05）與深層投入（β= .57, *p*<.001）皆達顯著，但在加入精熟、趨向表現及逃避表現三種中介變項預測結果變項後，知識/認識觀對淺層、深層認知投入的估計參數值皆不再顯著，證實中介關係確實存在，顯示中小學生所持知識/認識觀會透過精熟、趨向表現及逃避表現的中介，間接影響淺層與深層的認知投入策略使用。

# 社會建構的探究情境中科學學習動機與知識論表現之研究

蔡執仲[1]　　段曉林[2]

[1]高雄師範大學科學教育所　[2]彰化師範大學科學教育所

　　本研究在國二的自然與生活科技課中,建立探究的實務社群,在社會建構的情境中探討對學習動機與知識論的影響。共有 45 位學生參與,問卷使用「科學學習動機問卷」與「科學知識觀與探究能力問卷」兩份,在教學改變前進行前測,並歷經一個學期的探究學習後實施後測。收集的數據進行 t 檢定與路徑分析。結果顯示學生的學習動機顯著的朝向內在化,並且知識論也朝向建構論的取向。此外學習動機在「科學學習價值」與「主動學習策略」對於知識論中的「創造性」與「暫時性」有較強的關係。

# 電腦支援合作學習環境下大學生之社群知識共構

吳佳蓉

國立政治大學教育學系

　　本研究的主要目的在於探究學生如何透過數位學習平台以進行網路合作學習、並共構自然科學史知識的歷程。研究對象為修習「自然科學概論」的大學生(N=42)。教學設計上主要運用知識翻新（knowledge building）(Scardamalia, 2002)教育理念為基礎所建立的數位學習環境—知識論壇(Knowledge Forum)—以進行線上合作學習。教學目標主要在幫助學生瞭解自然科學的內涵與歷史發展，並希望藉由集體分享與知識共構的方式讓學生在平台上建構科學史。資料來源主要為學生在知識論壇平台上討論與對話的貼文。資料分析主要透過內容分析法，以分析學生對科學理論發展的理解。初步結果顯示，學生經過一學期在「知識論壇」上的學習後，對科學家與科學理論互動關係、科學知識的創新、與科學理論如何演化已有更深層的理解，並逐漸體認到科學理論並非是永恒不變的真理，而是可以透過與其他科學家的合作或辯證，及與其它科學理論互相激盪而持續演化、並不斷被翻新的。學生也因此而能更進一步瞭解科學理論是如何被集體建構的過程。

# 數學解題知識在知識/認識觀與數學解題表現間中介效果之檢驗

劉佩雲[1*]　　　古祐彰[2]　　　劉恆昌[3]

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　　數學為科學之母，在國小教育階段，面對結構不佳之非例行性數學文字題不但涉及對知識本質（the nature of knowledge）或知曉（knowing）本質與過程看法之知識/認識觀（personal epistemology）（Hofer & Pintrich, 1997; Kitchener, 1983）；還與個人語文理解與認知能力密切相關。本研究應用 Mayer（1992）之問題轉譯、整合、計畫與監控、解題執行四階段解題歷程及語言、語意、基模、策略與程序性知識進行探究，採質量混合法，問卷施測取北台灣地區 311 位國小五年級學生為對象（男生 161 人，女生 150 人）；再以最大變異取樣法篩選知識/認識觀得分兩極端者之高、低知識/認識觀學生各四名進行數學解題歷程回溯晤談。以 SPSS 15.0 for Windows 進行統計分析，結果發現知識/認識觀、數學解題知識、歷程與解題表現間均呈顯著正向相關，亦證實數學解題知識在知識/認識觀與數學解題表現之間的中介效果，且具 61% ～75% 的高解釋量，凸顯數學解題知識對數學文字題解題表現的強大效果，其中知識確定信念與基模、語言、語意知識對數學解題表現最具預測力。

# 國小低年級學童對科學相關職業的意象

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　　本研究目的在探討國小低年級學童對科學相關職業的意象。研究工具為「與科學相關職業形象之問卷」。研究樣本為地處偏遠國小中低年級學童共計77人。研究結果發現：學童對醫生及護士因為性別有刻板的特定意象，也就是大多數認為醫生是男性，而護士是女性的意象，但在科學家和科學教師不受既定印象影響而是呈現自我性別的投射，從研究結果可知，中低年級的學童在科學本質上有正向的科學家意像，則部分比例學童尚未建立相關職業之意象，因此在國小中低年級階段，進行科學的性別教育能夠提升從事學職業沒有性別的差異，並可做為未來職業生涯的選擇。

# Paper presentation
**Day 1**
**Session A2 / 1440- 1630**
**IB201**

# Facilitating belief change among in-service teachers and teacher-education students through knowledge-building community

Ching Sing Chai* and Huang-Yao Hong**

*Nanyang Technological University, Singapore

**National Chengchi University, Taiwan

This paper reports three case studies that investigate teachers' and teacher-education students' epistemological and pedagogical beliefs in two countries, Singapore and Taiwan, and how these beliefs changed after they have completed learning and/or teaching in a knowledge-building community (KBC).

Bereiter and Scardamalia (2006) argue that given the challenge of preparing learners for the 21st century, it is important for schools and classrooms to be redesigned as KBCs. The KBC is a student-centered pedagogical model that encourages students' collaborative construction of knowledge.  Implementing the KBC however, require substantial effort in shifting teachers' epistemological and pedagogical beliefs and practices (Lim & Chai, 2008). We argue that to enable such shift in teachers' beliefs, it is necessary to engage teachers in experiencing the processes of co-constructing knowledge, which will form the basis for them to reflect upon their beliefs and practices. In the present research, we reported three case studies in which both in-service teachers and future teachers (i.e., teacher-education students) were facilitated to learn in KBCs.

For the first two studies in particular, after the intervention, the changes in epistemology were not obvious among teachers who were assessed as relativist or committed relativist. Two teachers who were holding multiplistic outlooks however seemed to have become more relativist. As for changes in pedagogical beliefs, the teachers seemed to have gained more confident that students are capable of assuming epistemic agency. They also seem to be more comfortable with the role of facilitator and they are more willing to let go of control. As for the third study, the findings indicate that engaging students to work in a knowledge-building community is helpful in making them become more socially collaborative and reflective and in shifting their epistemological and pedagogical beliefs to become more constructivist-oriented. In summary, the observed shifts in beliefs are likely to foster recent reform efforts in both Singapore and Taiwan in moving towards constructivist pedagogies.

# Effects of computer-supported collaborative knowledge building on college students' views on science and science teaching

Yu-Hui Chang

Department of Education, National Chengchi University, Taiwan

The present study was conducted in a computer-supported collaborative learning (CSCL) platform called Knowledge Forum (KF) and the purpose was to investigate the effects of this KF environment on students' beliefs in science teaching and learning. Participants in this study were 19 teacher-education students who took a course called "Study of Subject Matter and Teaching Methods in Elementary School Natural Sciences" offered by a teacher-education program in a national university, Taiwan. Participants' ages range from 19 to 24 (M=20.79, SD=1.08) and none of them had any prior teaching experiences. The duration of the study was a school semester, which was about eighteen-week long. Data mainly came from (1) online activities automatically recorded in a KF database; (2) a "nature of science" questionnaire; and (3) a survey with six open-ended questions concerning with ideal science teaching and learning. Data analyses revealed positive changes in students' views on science and science teaching in two main areas, including: (1) improved understanding of the evolutionary and creative nature of scientific knowledge; and (2) a more student-centered view on science teaching. Further content analyses on students' online discourse will be conducted to better understand these processes of change.

# Teacher as an authority in knowledge among Chinese students: A cultural interpretation and developmental change

Angel Kit Yi Wong and Eric Siu Chung Lo
Hong Kong Institute of Education, Hong Kong, PRC

The epistemological belief concerning Omniscient Authority proposed by Schommer (1993, 1998) was empirically verifiable primarily in studies with Chinese students (e.g. Chan, 2000; Chan & Elliott, 2004; Lin, 2001; Wong *et al.*, 2009). One of the objectives of this presentation is to interpret the existence of the belief concerning teachers as authoritative knowledge provider among Chinese students as a cultural-specific phenomenon. The relational analytic scheme (Ho *et al.*, 2001) and the dual-component theory of filial piety (Yeh, 2005) would be used as conceptual frameworks in this analysis. The second objective of our study is to examine the development of epistemological beliefs of Chinese students, in particular the belief of teacher as authority in knowledge. The Epistemological Beliefs Questionnaire (EBQ) that has been adapted for Hong Kong students by Chan and Elliot's (2002) was completed by 549 first year and year 4 teacher education students, followed by a small-scale in-depth interview. Questionnaire results indicated first year students had significantly stronger belief in the authority of teachers as knowledge provider than their fourth year seniors. Unlike their western counterparts who usually become more doubtful in the certainty of knowledge with increased educational experience, significant statistical developmental difference was not found in the related epistemological belief dimension. However, interview data revealed that the freshmen were more prone to question the validity of teacher's knowledge, but not yet confident enough to turn this skepticism into more independent knowledge acquisition in actual practice. A contrary pattern was expressed by the year 4 students. The different belief pattern of the two cohort groups may reflect their different educational experiences and perception of teacher-student relationships.

# The change in Singaporean pre-service teachers' epistemological beliefs

Ching Sing Chai
Nanyang Technological University, Singapore

This study conducted a pre- and post-survey with 413 pre-service teachers in Singapore at the beginning and the end of their teacher preparation program to address the gap in this area of research, employing an online survey adapted from Chan and Elliott (2004). A paired-samples $t$ test was conducted to assess the change in pre-service teachers' epistemological beliefs.

The results indicate significant changes in pre-service teachers' beliefs about Certainty of Knowledge, $t(413) = 2.53$, $p < .05$, and Authority/Expert as source of Knowledge, $t(413) = 36.08$, $p < .01$. The changes in the mean scores of these two dimensions suggest that the teachers become generally relativistic in their epistemological outlooks at the end of the program. The trend of development parallel Brownlee's (2004) report. For beliefs about learning, there are significant changes in Learning Effort, $t(413) = 2.35$, $p < .05$, and Innate Ability, $t(413) = -5.18$, $p < .01$. Before and after the teacher preparation program, the teachers are inclined to see learning processes as very important. Chai and Khine's (2008) study based on a multicultural sample that includes Chinese, Malay and Indians indicates similar profile of beliefs about learning. In this study, the mean score of the Learning Effort dimension drops while the mean score of Innate Ability increases, suggesting that pre-service teachers seem to value effort in learning less and believe more in ability as innate at the end of their teacher preparatory program. The findings indicate that while the pre-service teachers become more relativistic in their epistemological outlooks, and they believe more in innate ability. We conjecture that these shifts are the effects of practicum or first year teaching. Future work can be carried out to verify the conjectures through in-depth interview with the beginning teachers.

# Change of in-service teachers' perceptions about science in a history of science course

Pi-Chu Kuo

National Pingtung University of Education, Taiwan

Teachers' perceptions about science are strongly affected by their personal learning experiences and will play an important role on their teaching practices. The main purposes of this study were to explore eight in-service teachers' perceptions about science and how their perceptions changed as they follow the reflective discourses in a History of Science course. The eight participants are graduate students for their Master of Education degree. History and Philosophy of Science is a requirement in the program. Although all of them are in science education program with science or math background, not all of them teach science. The eight weeks of History of Science course, 24 hours in total, were basically reviewing important historical scientific discovery in different eras followed by reflective discussions on the characteristics of science and scientists in different eras. Example discussion topics included: What is science? Is mathematics the foundation of science? What are the relationships of science and technology? How does scientific knowledge form? The participants were asked to write down their ideas on individuals' notebooks before the instructor opened group discussions. Some of the important topics raised over and over again to enhance their thinking and reflection. Observation notes were taken by the instructor when significant discussions happened. Quantitative data was collected before and after the eight weeks of discussions using Views on Nature of Science Questionnaire developed by Tsai and Liu in 2005. Paired t-test was implemented to compare the difference of views on science. The results were used as a reference of qualitative data obtained from content analysis of participants' notebooks, instructor's field notes, and the participants' essays on "What History of Science Tells Us about Nature of Science". The results showed that even their views of science did not change much on Views on Nature of Science Questionnaire, their epistemological beliefs about science were no longer limited within their personal major displicines or what textbooks and teachers said.

# Paper presentation

**Day 2**
**Session A3 / 1040- 1200**
**IB201**

# The effects of different instructional strategies on high school students' on-line searching outcomes and conceptual learning outcomes: The role of epistemological beliefs

Ying-Tien Wu

Department of Science Application and Dissemination, National Taichung University, Taiwan

This study was conducted to explore the effects of two different on-line searching activities on students searching outcomes and cognitive structure outcomes. Also, the role of learners' scientific epistemological beliefs (SEBs) play in these on-line searching tasks is also examined. The participants were 68 tenth graders in Taiwan. By using a quasi-experimental research approach, thirty-three students were assigned to a "guided searching task group", while thirty-five students were assigned to an "unguided searching task group". "Nuclear power usage" was used as the topic for on-line searching tasks. All the participants were asked to search relevant information regarding nuclear power usage on the Internet and integrate what they have searched into a report during the period of two classes (100 minutes). The students in the un-guided searching task group were asked to search freely, while those in the guided searching task group were provided with a searching guideline. Before the conduct of this study, the participants' SEBs was assessed. Their cognitive structure outcomes were assessed before and after the searching tasks. The students' on-line searching outcomes were evaluated by grading their searching reports. This study found that the two groups of students did not show any significant difference on their searching outcomes ($p>0.05$). However, in guided on-line searching group, significant differences on students' conceptual understanding before and after completing online searching task were revealed ($p<0.05$), while, in un-guided on-line searching group, no significant difference on students' conceptual understanding were found before and after online searching ($p>0.05$). The findings above seems to reminder instructors that that learners' better searching outcomes do not guarantee for their better conceptual learning outcomes after completing the on-line searching tasks. Moreover, the interaction between students' SEBs and instructional conditions on students' searching outcomes was found in this study. Similarly, the interaction between students' SEBs and on-line searching task on student usage of the "inferring or explaining" information processing mode was also found. The findings above suggests that, when trying to improve students' on-line searching outcomes in Internet-based learning environments, science instructors should pay more attention to the role of learners' epistemological beliefs.

# High school students' online search for solving well-structured scientific problems: Predicting achievements by scientific epistemological views and online information searching strategies

Meng-Jung Tsai*, Fang-Ying Yang** and Chin-Chung Tsai*
*National Taiwan University of Science & Technology, Taiwan
**National Taiwan Normal University, Taiwan

This study was aimed at examining if students' online search achievements can be significantly predicted by their scientific epistemological views and online information searching strategies. A total of 145 $10^{th}$ graders enrolled in a required computer course served as subjects of this study. All of the subjects were asked to perform an online searching task in order to solve a set of well-structured scientific problems. Two instruments, the Scientific Epistemological Views Instrument and the Online Information Searching Strategies Inventory, were used in this study. Students' problem solving achievements were determined by their responses to the scientific problems after the searching task. The responses were evaluated by one high school science teacher and one science educator in three dimensions including correctness, integration and abundance. Multiple regression analyses were used to analyze the data. The results indicated that both high school students' scientific epistemological views and their online searching strategies can significantly predict their problem solving achievements in all three dimensions via online search for well-structured scientific problems.

# University students' scientific epistemological views and online information searching strategies in solving ill-structured scientific problems via online search

Yu-Hsin Chen*, Meng-Jung Tsai* and Fang-Ying Yang**

*National Taiwan University of Science & Technology, Taiwan

**National Taiwan Normal University, Taiwan

This study examined the roles of scientific epistemological views and online information searching strategies in university students' online searching for solving an ill-structured scientific problem. A total of 240 questionnaires including the Scientific Epistemological Views (SEV) instrument were administered to college and graduate students with both social science and natural science backgrounds. The authors used the semi-interquartile range to select the higher and the lower SEV scores and a total of 45 subjects were then selected to participate in an online searching task to solve an ill-structured scientific problem. Before the task, the subjects were given two news reports with opposite positions regarding a controversial scientific issue. Students' online searching strategies were evaluated by the Online Information Searching Strategies Inventory right after the task. Also, the processes of online searching were screen captured for all subjects. In addition, students' positions of the problem were examined before and after the online searching. The findings in general suggested that students' scientific epistemological views were difference between college and graduate students. For example, college students' scientific epistemological views were more constructivist-oriented than graduate students, especially in justification. Also, college students' online information searching strategies were also better than graduate students. In addition, we also found some interesting things between social science students and natural science students. For example, social science students' scientific epistemological views and online information searching strategies were more advanced than natural science students. Finally, the results showed that university students' scientific epistemological beliefs and online information searching strategies can significantly predict their ill-structured problem solving via online search.

# Experienced college instructors' personal epistemology in teaching social studies and their perception of using technology

Li-Chu Sung

Ming Chuan University, Taiwan

Good teaching practice comes from experience. Experience includes explicit and tacit knowledge. Explicit knowledge is from a person's 'espoused theory', which is what a person believes and claims to follow. Tacit knowledge is from a person's 'theory-in-use', which lies behind a person's action or behavior. The knowledge of teaching demonstrated in the classroom can be referred to as tacit knowledge or theory-in-use, which is often the theory behind the practice of experienced teachers. Elbaz (1983) points out that the 'experience' is referred to as 'practical knowledge,' which "provides the basis for a conceptualization which sees the teacher as possessing valuable resources" (p.6) and allows a teacher to explicitly indicate and also tacitly demonstrate his or her experience in teaching. The theoretical framework is based on Nonaka's 'explicit and tacit knowledge', Argyris & Schön's 'espoused theory' and 'theory-in-use,' and Popper's 'trial-and-error' revolutionary epistemology.'

This study adopts a social constructivist approach (Stake, 1995) to investigate two research questions: (1) What is experienced instructors' personal epistemology in teaching social studies? (2) What is their perception of using technology in the classroom? Two forms of data collection were used: (A) a concept map and (B) a final reflection. Three experienced college instructors teaching social studies were selected for this study. Each instructor was asked to generate nine good teaching qualities. Then they drew their concept map based on the nine teaching qualities they generated. The purpose of the study is to investigate how experienced college instructors applied their good teaching qualities to teaching social studies. Their concept maps reflected their theory-in-use and showed the relationship among their teaching qualities by displaying them together in a graphic form and how each teaching quality is connected to another. In addition, participants' use of technology was also explored to get their perception of the role of technology and their actual use of technology in teaching. Their concept map data were later e-mailed to them to validate the data and reflect on their actual classroom teaching and use of technology in teaching.

Based on the findings, the three instructors were teaching under different schema. However, most of them seemed to treat the content, such as democracy education, as their ends and thus used pedagogy, including technology, as the means to reach the ends. Their use of technology also reflected their perception of the role of technology in teaching and revealed their limited understanding of technology integration, which leads to some potential problems. The findings show that instructors decide what their means and ends (or process and content) should be and how technology can really help facilitate teaching and enhance learning. It is hoped that the exploration of the three experienced instructors' personal epistemology, thinking and action in teaching social studies can provide some insights to instructors and pre-service teachers in similar or other fields who endeavor to achieve effective teaching practice.

# Paper presentation

**Day 2**
**Session A4 / 1300- 1400**
**IB201**

# The relationships between epistemological beliefs in biology and approaches to learning biology among biology-major university students in Taiwan

Yi-Chun Lin and Jyh-Chong Liang
National Taiwan University of Science and Technology, Taiwan

This study aimed to investigate the relationships between students' biology epistemological beliefs and their approaches to learning biology. Two instruments, Epistemological Beliefs in Biology (EBB) and Approaches to Learning Biology survey (ALB), were developed and administrated to 687 university biology students to investigate their epistemological beliefs in biology and approaches to learning biology, respectively. The results showed that both EBB and ALB have adequate validity and reliability for assessing students' epistemological beliefs in biology and approaches to learning biology. Students' epistemological beliefs in biology such as 'Source' and 'Certainty' were both negatively related to their surface approaches to learning biology such as 'Surface Motive' and 'Surface Strategy.' Students' epistemological beliefs in biology such as 'Development' and 'Justification' were positively associated with both their deep and surface approaches such as 'Deep Motive,' 'Deep Strategy' and 'Surface Motive,' and both were negatively related to surface approaches, 'Surface Strategy,' to learning biology.

# Is physics more certain and coherent than biology? A comparison of students' domain specific epistemological beliefs

Silvia Wen-Yu Lee

Graduate Institute of Science Education, National Changhua University of Education, Taiwan

Among recent studies of students' epistemological beliefs, great attention has been devoted to science education. However, investigation across different domains of science is rare. The major purpose of this study is to compare students' scientific epistemological beliefs (SEBs) in biology and physics. In this qualitative study, interviews were conducted to compare students' beliefs about biology and physics for the "simplicity" and "certainty" dimensions defined in previous studies. The results suggest a framework with four dimensions of SEBs. This study suggested that the simplicity dimension has a greater tendency to be domain specific while the certainty dimension had almost equal tendency to be domain specific or domain general, depending on how one defined "certainty." The finding that physic is more certain than biology echoes the findings in some previous studies but provided more in-depth explanation. This study concludes that domain-general and domain-specific SEBs coexist for different science domains, and that some dimensions of SEBs may be nested. Suggestions regarding revision or clarification of some previously defined dimensions of SEBs are provided.

# Museum science teaching: Museum science educators' personal epistemology and the learning experiences they created for visitors

Jung-Hua Yeh

Science Education Department, National Museum of Natural Science, Taiwan

Museum has long been widely regarded as a place for self-learning. For the consumers in a late capitalist society, museum —not much different from an theme park — is also an option among others for leisure time. For museum in a time of redefining and readjusting its role in a rapid changing society, how to facilitate and enhance visitor's engagement with learning activities—along with its functions as places of entertainment and education—has become one of the major challenges. To represent itself as an attracting place of learning, especially for visitors of a younger generation, museum has been exploring and adopting group learning approach to intensify visitor's experience of 3E (entertainment, education, engagement). Group learning approaches are mostly conducted by museum educators—some of them are full-time professionals employed by the museum, the others are school teachers working as volunteers with long-standing involvement in designing and evaluating museum education programs. These educators convey the first impression of museum to the young students in a field trip. Moreover, the educators' epistemological beliefs or reflective judgment play a key role in determining what kind of science education program the visitors are going to receive from the museum.

The aim of this study is to explore the following two questions: 1) What kind of personal epistemology are the educators committed to? 2) How does the personal epistemology inform and help to organize an educator's teaching practice? Two educators were interviewed to reveal their own epistemological beliefs or reflective judgment of scientific knowledge. To analyze the influence of epistemological beliefs on the teaching practices, the ways these two educators' carry out their education program were compared and analyzed. This study employ the framework developed by Schommer(1994) to characterize and analyze the educators' epistemological beliefs of scientific knowledge and science education. By participating in, observing and documenting the educators' teaching processes, the author of this study wishes to shed light on the link between the personal epistemology and teaching practice. One of the educators in this study regarded scientific knowledge as rigorously structuralized with high-degree of certainty, provided by authorized sources and endorsed by experts. This educator tended to employ well-structuralized elucidation with fixed sequence and contents, emphasizing the guiding role of the instructor. The educator with this kind of epistemological belief put great stress on the contents of scientific knowledge, but not on scientific methods and science process skills. Accordingly, this educator did not value highly the potential of a student to acquire knowledge for himself through observation and discussion alone.

The other educator regarded scientific knowledge as loosely structuralized with various degrees of certainty, provided by multiple sources without an centralized authority. This educator tended to encourage visitors to actively participate in the process of observing, proposing hypotheses and carrying out induction. The educator with this kind of epistemological belief viewed both the contents of and the ability to explore scientific knowledge— that is, scientific methods and science process skills—as equally important. Since the contents of scientific knowledge have been overemphasized in the formal education, so argued this second educator, informal learning setting should put more stress on experiencing scientific methods and science process skills. Likewise, museum should provide a learning environment that encourages visitors themselves to perform and think like real scientists in exploring scientific methods and applying their science process skills. Based on this investigation, some suggestions were made to improve the program and practice of museum science education.

**The Asia-Pacific Education Researcher (indexed in SSCI) will publish a special issue on Asian Personal Epistemologies, 2010 first issue. The PEL participants will receive an e-mail to get free access to the full text of the articles. The tentative table of content is:**

Asian personal epistemologies and beyond: Overview and some reflections

**Benjamin Wong, Ching Sing Chai**

The role of epistemological beliefs in Hong Kong preservice teachers' learning

**Kwok Wai Chan**

Modelling the relationships among beliefs about learning, knowledge, and teaching of pre-service teachers in Singapore

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The relations between scientific epistemological beliefs and approaches to learning science among science-major undergraduates in Taiwan

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Epistemological beliefs and theory of planned behavior: Examining beliefs about knowledge and knowing as distal predictors of Indonesian tertiary students' intention to study

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Linking students' epistemological beliefs with their metacognition in a chemistry classroom

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Exploring high school students' views regarding the nature of scientific theory: A study in Taiwan

**Meichun Lydia Wen, Pi-Chu Kuo, Chun-Yen Chang, Chin-Chung Tsai**

Summary and conclusion (Tentative)

**Barbara Hofer**

# Personal Epistemology and Learning (PEL) conference

個人知識／認識觀與學習國際研討會

【會議日期】2009 年 12 月 16 日、12 月 17 日
【會議地點】國立台灣科技大學國際大樓
【主辦單位】行政院國家科學委員會 科學教育發展處
國立台灣科技大學