Global Chinese Conference on Science Education 2010
全球華人科學教育會議 2010

Programme Book & Abstract
會議指南及論文摘要

20-21 December 2010

Organized by:

Department of Science and Environmental Studies,
The Hong Kong Institute of Education

Co-organized by:

National Association for Science Education (CNASE), the Chinese Society of Education
Chief Executive's Award for Teaching Excellence Teachers Association
Faculty of Education, The Chinese University of Hong Kong
Faculty of Education, The University of Hong Kong
Hong Kong Association for Science and Mathematics Education
Hong Kong Education City Limited
Hong Kong Educational Research Association
School of Science, The Hong Kong University of Science and Technology

Sponsored by:

Education Bureau
Faulty of Arts and Sciences (FAS), The Hong Kong Institute of Education

Table of Contents

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Dr. Winnie SO Wing Mui (蘇詠梅博士)
Head, Department of Science and Environmental Studies,
The Hong Kong Institute of Education
Chairperson, Organizing Committee of GCCSE 2010

Welcoming Message

Dear Guests and Participants,

Over the past decade, the scientific development of China has taken a great leap forward and it is now on par with several countries that are traditionally strong in science and technology, such as the United States, Japan and the European Union, etc. The United Nations Educational, Scientific and Cultural Organization (UNESCO) has pointed out in their World Science Report 2010, that China has been catching up with these countries in terms of the number of researchers and the amount of resources spent on nurturing talents. China's scientific achievements are impressive in many fields. The nation has designed and has built her first deep-sea manned submersible "Jiao Long", which has successfully set a world record and has planted the Chinese national flag on the seabed. Also, she has the world's fastest and longest high-speed railway train system. Moreover, she has successfully launched the moon probe Chang'e II and has built the world's fastest supercomputer Tianhe-1, etc. All of these are a clear manifestation of the scientific accomplishments of China in the contemporary world. Furthermore, overseas Chinese scientists around the world have also received many major international science awards. Behind these glorious achievements, however, there is still room for improvement in journal citation, originality and impact of research, quality of academic papers etc.

In light of this, the GCCSE 2010, titled "Connecting science education to the contemporary world", aims at bringing together scholars and educators around the globe who are interested in science education in the Chinese communities to discuss and to share ideas, practices and recent development in science education. This two-day conference focuses on research and development of science curriculum, teaching and assessment practices in primary, secondary and tertiary science education through keynote addresses, oral paper presentations, workshops, poster sessions and symposiums etc. All these activities allow participants to voice their concerns and share their experiences in the learning, teaching and assessment of science, which are relevant to the needs and development of the science education community around the world.

We sincerely hope that this GCCSE would provide distinguished scholars and educators with an effective platform for academic exchange, in order to create a better outlook and more chances for further development in the field of science education in Chinese communities. We are pleased to have Mrs. Rita FAN Hsu Lai Tai, Member of the Standing Committee of the Eleventh National People's Congress of the People's Republic of China and the Former President of the Legislative Council of Hong Kong, and Mr. Kenneth CHEN Wei On, Under Secretary for Education, as the guests of honour; Professor Marcia LINN from the Graduate School of Education of the University of California (Berkeley) in the USA and Professor Svein SJØBERG from the Department of Teacher Education and School Development of the University of Oslo in Norway as keynote speakers; as well as Professor CAI Tie Quan from Zhejiang Normal University in China, Professor GUO Chrong Jee from the College of Science of the National Changhua University of Education in Taiwan, Dr. May CHENG May Hung from the Department of Education of the University of Oxford in the UK, and Dr. Philip G STIMPSON from the Faculty of Education of The University of Hong Kong as invited speakers. We are grateful for the precious time you all have taken out of your busy schedules to take part in this conference.

The Department of Science and Environmental Studies of The Hong Kong Institute of Education is honoured to hold the first Global Chinese Conference on Science Education, yet this conference would not have been possible without the kind support and active participation of all participants and the following co-organizers: the National Association for Science Education (CNASE) of the Chinese Society of Education, the Chief Executive's Award Winner for Teaching Excellence Teachers Association, the Faculty of Education of The Chinese University of Hong Kong, the Faculty of Education of The University of Hong Kong, Hong Kong Association for Science and Mathematics Education, Hong Kong Education City Limited, Hong Kong Educational Research Association and the School of Science of The Hong Kong University of Science and Technology. We would like to take this opportunity to express our heartfelt thanks to all of you.

We wish you a fruitful conference!

Chairperson 大會主席

Dr. YEUNG Yau Yuen (楊友源博士)
Associate Head, Department of Science and Environmental Studies,
The Hong Kong Institute of Education
Chairperson, Organizing Committee of GCCSE 2010

歡迎辭

各位與會者：

回顧過去十年，中國的科技發展可謂一日千里，有目共睹。今天，中國的科技在許多方面均可媲美美國、日本和歐盟等多個科技強國。聯合國教科文組織在早前的《2010 科學報告》中指出，中國無論在研究人員數量或培育人才等方面都已逐漸逼近科技強國的水準。事實上，中國的科研實力可見於多個領域：海上有首台自行設計製造的載人潛水器「蛟龍號」，成功創下世界紀錄，並在海底插上中國國旗；陸上有全球最長、最快的高鐵列車系統；空中則有成功發射的探月衛星嫦娥二號；還有堪稱全球最快的超級電腦天河一號等等。這些創舉都彰顯了中國近年的科技成就。此外，海外的華人科學家也屢次榮獲多項國際科學大獎。然而，在這些光輝成就的背後，中國在文獻引用、科研原創性和影響力，以及論文品質等數個科研表現層面仍然有進步的空間。

全球華人科學教育會議 2010 以「科學教育與當代世界」爲題，旨在凝聚世界各地對華人社會的科學教育感興趣的學者和教育工作者，並藉此共同探討科學教育、交流研究成果及分享教學策略。在爲期兩天的會議中，我們將透過演講、工作坊、講座、海報展覽發表、分組論文報告及專題研討會等探討小學、中學及大學的科學課程、教與學及評估方面的研究及專業發展，讓各位表達對科學教育的學、教、評的關注及分享經驗，以迎合現今科學教育社群的需要及發展。

我們熱切希望本屆全球華人科學教育會議能夠為一眾出色的學者和教育工作者提供一個有效的學術交流平臺，務求為全球華人科學教育工作帶來新的景象以及更好的發展。我們很榮幸能邀請到主禮嘉賓：中華人民共和國第十一屆全國人民代表大會常務委員會委員暨前香港立法會主席**范徐麗泰女士**、香港教育局副局長**陳維安太平紳士**，以及演講嘉賓：美國柏克萊加州大學教育研究院教授 **Professor Marcia LINN**、挪威奧斯陸大學師資培育與學校發展系教授 **Professor Svein SJØBERG**、中國浙江師範大學教授**蔡鐵權教授**、臺灣國立彰化師範大學理學院講座教授**郭重吉教授**、英國牛津大學教育學院的**鄭美紅博士**和已退休的香港大學教育學院副教授 **Dr. Philip G STIMPSON** 參與會議。承蒙各位主禮嘉賓和演講嘉賓於百忙之中撥冗參與，我們實在不勝感激。

香港教育學院科學與環境學系十分榮幸能主辦第一屆全球華人科學教育會議。是次會議得以順利籌辦，全賴在座各位科學教育工作者的積極參與及以下各個協辦機構的鼎力支持，包括中國教育學會科學教育分會、香港中文大學教育學院、香港大學教育學院、香港行政長官卓越教學獎教師協會、香港科技大學理學院、香港教育城、香港教育研究學會，以及香港數理教育學會。我們僅此致以**衷心的感謝**。

最後，祝願大家於本屆全球華人科學教育會議中取得豐厚的成果。

Guest of Honour 主禮嘉賓

Mrs. Rita FAN Hsu Lai Tai (范徐麗泰女士)
People's Republic of Eleventh National People's Congress Standing Committee
Former President of the Legislative Council of Hong Kong

Welcoming Message 歡迎辭

蘇博士、楊博士、各位教授、各位來賓：

大家好！

我是一個念理科出身的人。在幾年大學裡面以及在中學裡面，我學的是化學物理生物。後來我的工作前後 23 年都是在高等學院度過。所以，我自己覺得，在我們的教育過程裡面，一個很重要也很核心的元素就是培養我們年輕的一代，用客觀的方式去觀察、去記錄、去分析，然後達成自己的一個結論。這一種客觀的觀察與分析，實際上就是重視一些外來的資料，不會因為個人的喜愛或是偏見，而將一些重要的資料放過一邊，允許自己去達成一個比較偏頗的結論。如果對每一件事情不能夠客觀的去分析，結果就是，自己以為自己是對的，可是實際上並不符合現實的實際情況。所以我覺得，科學的論證方法實際上在教育過程裡面是一個很重要的因素。比如說，我們的年輕人在學校裡面，他們要去組織一項活動，讓他們有機會去經歷，實際上的去感受一下組織活動的挑戰在哪裡？在這個過程裡面，他們必須要用他們自己的能力，有系統的、有步驟地、一步一步得去計畫，然後去落實。 如果我們用的方法就是老師們告訴他們怎麼做才是最好的，最對的，我相信老師是對的，可是，結果就是學生們學不到怎麼樣用他們自己的分析能力，獨立思考，去籌備一個活動。同樣的，當他們來到社會上工作的時候，他們也需要考慮客觀的環境。他們不能夠太自我。他們也要用觀察的能力去看四周圍和他們一塊兒工作的團隊。團隊裡面，誰的長處在哪裡，誰的弱點在哪裡。然後如果有一天，這位年輕人他要去領導這個團隊的時候，他就能夠給每一位團員安排上他們所能夠勝任的工作，也將他們互相之間的長處和弱點互補工作。所以，這個也是一種科學化的做人做事的方法。說到更重要一點，就是統治一個地方，為人民服務。如果用的方式，不是一個科學發展觀、不是尊重事實、不是透過客觀的分析而決定的事情，反而用的是最高級的人去決定一切，我相信這個決定在執行的時候必然會遇見很大的困難，也必然得不到他預期的結果。所以在教育的過程裡面，能夠令我們的學生明白到用科學的方式，有系統的、有步驟的、客觀的去觀察，獨立的去思考，而且是客觀的去分析的話，那我相信我們的學生必然會受益不淺。而我們作為教育者，也能夠得到一定程度的滿足。所以我個人的淺見是，「科學」在我們的教育過程裡面，是必不可少的。以此，和在座的各位共勉。我覺得大家是卓越英才。你們的工作對我們的將來，對我們的年輕人，實在是太重要了。希望透過大家的努力，將我們的教育做的更完美，令年輕人更能夠得到受益，令科學的理想更能夠在教育中顯露出來。

謝謝大家。

Guest of Honour 主禮嘉賓

Mr. Kenneth CHEN Wei On, JP (陳維安太平紳士)

Under Secretary for Education

Welcoming Message 歡迎辭

Dear Guests and Participants,

It gives me great pleasure to be the Guest of Honour of this meaningful event: The Global Chinese Conference on Science Education 2010.

The emergence of a highly competitive and integrated world economy, rapid scientific and technological innovations and the ever-growing knowledge base have called for a new way of educating our young people. Science education in Hong Kong aims at developing students' scientific literacy and enhancing their interest, a sense of wonder and curiosity about the natural world. Besides equipping students with a concrete knowledge foundation of science, our curriculum has put much emphasis on the development of students' ability to think scientifically, critically and creatively, and to link science and technology with goals for environmental sustainability and the well-being of mankind.

As you all would agree, learning and teaching are interactive processes. To achieve the contemporary aims of science education, teachers' roles have to be redefined. Teachers are expected to be more proactive in exploring and trying out different pedagogical approaches and strategies to cater for diversified students' learning styles, interests, and abilities. We need to help our students learn science effectively and prepare them for active participation as citizens. Relevance is a key factor for motivating students to learn. Therefore, connecting science with students' personal lives, contemporary societal and environmental issues would enable students to develop an attitude of responsible citizenship.

The theme of this Conference "Connecting Science Education to the Contemporary World" is most befitting to the concerns of science teachers and educators today. With the implementation of the New Senior Science curriculum last year, the Conference provides a timely and valuable platform for our local teachers and educators to share ideas and practices with partners in the global Chinese communities. Teachers may draw on successful experiences in designing learning and teaching activities which are more suitable for their students. By learning the education trends of other countries/regions, science educators could reflect upon their own strategies in response to global development so as to face the challenges of this century.

I would like to take this opportunity to thank the Hong Kong Institute of Education for staging this meaningful event. I believe this two-day Conference would inspire those who are concerned about the effective learning of our students. I hope you could actively engage in discussions, exchange information and develop network with other participants.

I sincerely wish you all a most fruitful time at the Conference.

Thank you.

Guest of Honour 主禮嘉賓

Professor Joshua MOK Ka Ho (莫家豪教授)
Associate Vice President (External Relations),
Dean of Faculty of Arts and Sciences,
Chair Professor of Comparative Policy,
And Co-Director of Centre for Governance and Citizenship (CGC)

Welcoming Message 歡迎辭

Dear Guests and Participants,

The first **Global Chinese Conference on Science Education** provides opportunities for teachers, educators, scholars and researchers around the globe who are interested in science education in the Chinese communities to discuss and share ideas, practices and recent development in science education. The theme of the conference is "Connecting science education to the contemporary world".

The conference focuses on research and development of science curriculum, teaching and assessment practices in primary, secondary and tertiary science education. We anticipate to involve science educators and school science teachers from different parts of the world (e.g. Mainland, Taiwan, Macau, Singapore, Europe, the USA & Hong Kong) to exchange research work and best practices. There are workshops and seminars for sharing of concerns and experiences in the learning, teaching and assessment of science, which are relevant to the needs and development of the science education community around the world. In order to facilitate sharing and communication in the conference, presentations in English, Putonghua and Cantonese are welcomed.

I wish you a pleasant and fruitful conference.

各位來賓：

第一屆**全球華人科學教育會議**讓來自全球各地對華人社會的科學教育感興趣的科學老師、學者、教育工作者及研究者共同探討科學教育的觀點、實踐及最新發展。會議主題是「科學教育與當代世界」。

會議內容探討小學、中學及大學的科學課程、教與學及評估方面的研究及專業發展。期望來自中國大陸各省市、台灣、澳門、星馬、歐洲、美洲及香港的科學教育專家及學校老師在會議期間聚首一堂，交流研究成果及傑出教學策略。會議包括有工作坊及講座，讓各參與者分享對科學教育的學、教、評的關注及經驗，迎合現今科學教育社群的需要及發展。

我衷心祝願大家在會議中取得豐厚成果。

Conference Theme 會議主題

Main Theme:

Connecting Science Education to the Contemporary World

Sub-themes:

1. Integrating Science with Other Areas of Learning
2. ICT in Science Education
3. Learning and Teaching Science
4. Development of Science Curriculum
5. Assessment of Students' Science Learning and Development
6. Teacher Education/Professional Development for Teachers
7. Historical, Philosophical, Social, Cultural, and Gender Issues
8. Science Education in Life-wide/Authentic/Informal Contexts

主題：

科學教育與當代世界

副題：

1. 綜合科學與其他學科學習
2. 科學教育與科技
3. 科學教學策略
4. 科學課程發展
5. 學生科學學習與發展的評估
6. 科學教師培訓與教師專業發展
7. 與科學教育有關的歷史、哲學、社會、文化和性別事宜
8. 課外或全方位的科學教育

Keynote Speakers 大會主講嘉賓

Keynote Address 1:

Professor LINN Marcia
Professor, Graduate School of Education,
University of California, Berkeley, USA
Monday, 20 December 2010, 10:00-11:00, D1-LP-04

Visualizing science: Using technology to promote knowledge integration

Abstract

Science learning is most successful when instructional materials guide students to integrate their ideas. Evidence of efforts to understand scientific phenomena include the many intuitive ideas that students develop to explain the natural world. Based on the way metal objects feel in a typical classroom, many argue that metals are naturally cold—so they can keep things cold for a picnic. Others explain that plants eat dirt or that twins are children who look like each other. While inaccurate, these ideas represent attempts to interpret observations. Effective science education can help students build on their observations and develop coherent, integrated ideas.

Strengthening the ability to sort out conflicting explanations and make sense of complex scientific phenomena is essential today. Citizens need to sort out conflicting messages. They need to deal with persuasive messages about climate change, health decision-making, and effective energy policies. This talk will explore how scientific visualizations as part of a technology-enhanced, pedagogically-sound curriculum can improve the effectiveness and efficiency of science education and prepare lifelong science learners.

Scientific visualizations can make *unseen processes* such as chemical reactions or planetary motion *visible*, allow students to conduct *virtual experiments* about complex situations such as global climate change, airbag safety, or home insulation, and help students link *scientific representations* such as symbolic equations, models of unobservable processes (interactions among atomic particles, gravitational forces), and observable phenomena. I define visualizations as interactive, computer-based animations of scientific phenomena including models, simulations, and virtual experiments. Recent studies involving over 30,000 middle and high school students and 350 teachers conducted by the National Science Foundation funded Technology Enhanced Learning in Science (TELS) center illustrate promising uses of dynamic, interactive visualizations of phenomena to promote lifelong science learning.

Keynote Speakers 大會主講嘉賓

Keynote Address 2:

Professor SJØBERG Svein

Professor, Department of Teacher Education and School Development, University of Oslo, Norway

Tuesday, 21 December 2010, 09:00-10:00, D1-LP-04

Young people, science and technology: What survey research tells us about attitudes, interests, values and future plans

Abstract

This paper presents results and perspectives from the comparative project ROSE (The Relevance of Science Education) on how 15-year old learners relate to science and technology (S&T). ROSE is a cooperative, low-cost, grassroots undertaking with researchers from about 40 countries in all continents.

Among the findings are the following, which will be documented in the full paper:

Learners in all parts of the world agree about the importance of S&T for development as well as for the individual, although learners in the most affluent countries are more skeptical and ambivalent. Moreover, girls seem to be much more ambivalent that the boys, and the differences are most dramatic in the richest North-European countries and Japan.

Learners in less economically developed countries have a much higher interest in learning most aspects of S&T than the learners in highly developed countries. Learners in highly economically developed countries are also much more selective in their profile of interest.

Boys' and girls' interests in learning different aspects of S&T are also rather different, and seem to follow the same pattern in all countries:

Girls seem, in general, to be more interested in health and biology, ethical, social and environmental aspects of S&T, while boys are more interested in mechanical and electrical aspects of science. Boys are also more interested in dramatical, explosive and violent aspects of S&T than girls.

Girls and boys in all countries are very concerned about the importance of environmental protection, but they also have differing perspectives related to environmental challenges. Boys tend to think that the problems are exaggerated, and that they may fixed by experts. Girls think that the challenges are more serious, they also think that each of us may make a difference. Moreover, girls seem more than the boys willing to make sacrifices.

Boys and girls have rather different set of values that are important for their future choice of careers. Girls are 'people-oriented'. They like to work with other people, and they want to get a job where they may be of help for other people. Unfortunately, their perceptions of engineers or scientists do not seem to fit this 'people-oriented' image.

School science seems to fail in many respects. Young people in many countries, in particular the wealthy ones, like school science less than most other subjects. School science has to a small degree showed them the relevance of S&T for our culture and way of living. Moreover, school science has not opened their eyes for the importance of S&T for occupations and careers, and rather few think that school science will be of value for their future life. In most countries, there are large gender differences on all such questions.

ROSE details and publications are given at the home site: http://www.ils.uio.no/english/rose/.

Invited Speakers 小組演講嘉賓

Invited Speaker 1:

Professor CAI Tie Quan (蔡鐵權教授)
Professor, Zhejiang Normal University, China
Monday, 20 December 2010, 13:15-14:00, D1-LP-04

中國（大陸地區）科學教育的研究與發展

論文摘要

在世紀之交，爲了貫徹落實"科教興國"戰略，全面推進素質教育，中國（大陸地區）醞釀並啓動了面向 21 世紀的基礎教育課程改革。在此次基礎教育課程改革中，科學教育作爲其重要一部分而日益引起關注，由此引發了中國（大陸地區）對科學教育的廣泛研究。

通過我們長期的研究以及對中國知網有關科學教育文獻以及相關書籍的查閱，目前，中國（大陸地區）對科學教育的研究相比較上個世紀，已經有了質的飛躍。對科學教育所涉及的諸多問題均有學者關注和研究，均有一定數量的論文和著作。按科學教育研究每一領域的研究成果，可以將大陸地區科學教育的研究現狀分爲三種情況。

第一，已引起廣泛關注的：主要是科學教育中關於 STS 教育、科學哲學、提升學生科學素養、探究教學以及科學教育中的科學史運用方面的研究，成果蔚爲壯觀，論文多達幾千篇。第二，正引起廣泛關注的：主要是科學教育中的科學本質、前概念、迷思概念以及概念轉變的研究，對科學教學的有效策略（包括可視化工具運用，資訊技術與科學教學的整合等），科學教學考試以及評價的研究，目前在國內正引起關注，每一方面也有一些相關論文發表以及專著出版。但相比較前一類研究，研究成果較少，關注的學者也較少。第三，還沒有引起廣泛關注的：主要是科學教育的 SSI 教學、科學教師的 PCK 以及科學閱讀和科學寫作等。這些方面在大陸地區的研究成果寥寥無幾，研究的學者屈指可數，是大陸地區科學教育研究亟待重視的領域。

通過以上對中國（大陸地區）科學教育研究現狀的分析，可以清晰地瞭解目前大陸地區科學教育研究的著重點以及尚未被重視的領域。同時，在對大陸地區已有的科學教育研究成果進行審視的過程中，中國（大陸地區）在科學教育研究方面的特點也是顯而易見的，主要有四個方面。第一，研究缺乏系統性。如關於在科學教育中提升學生科學素養方面的研究，目前雖然成果頗多，但未成體系，深度不夠。第二，沒有形成研究團隊。許多學者對於科學教育的研究純屬個人行爲，還沒有形成關於某一問題研究的專門團隊或研究群體，這也是導致中國（大陸地區）科學教育研究不夠深入的原因之一。第三，對某一議題長期持續的研究與實踐的成果缺乏。至今，相當多的領域還只是停留在對國外研究的一般性介紹，未形成深入的理論研究和本土化實踐。第四，與國外、港澳臺等地區聯系和聯合欠缺。對研究的前沿把握不夠正確、及時，導致科學教育中的某些研究領域在我國（大陸地區）至今鮮有人關注和研究的現狀。

自改革開放以來，我國（大陸地區）科學教育的研究已有了長足的發展，視野大爲拓展，研究逐步深入，推動了科學教育的改革和發展，促進了科學教師的專業成長和專業隊伍的形成。我們面臨著挑戰，也面對著機遇。

Invited Speakers 小組演講嘉賓

Invited Speaker 2:

Professor GUO Chrong Jee (郭重吉教授)
Emeritus Professor, College of Science,
National Changhua University of Education, Taiwan
Tuesday, 21 December 2010, 10:00-10:45, D1-LP-04

亞洲華人地區數理教學與師資培育的挑戰與機會

論文摘要

基於全球化知識經濟時代的來臨和科學、技術與資訊的進步，為因應新的世局變化並確保持續發展的潛力，世界各國莫不紛紛從培育人才和提昇二十一世紀公民素養的角度，規劃與推動一些重大教育革新措施。本文中將簡要介紹近年來中國大陸、香港、新加坡和台灣等華人地區的教育政策或教育改革方案，並指出其對中小學科學(含數學)教育的推展所帶來的挑戰。中小學科學教育是全民基礎教育的重要一環，在數理科的教學中可以培養許多二十一世紀公民所應具備的核心能力。華人學生在參與國際數理評比的表現良好，而家長和社會大眾也普遍重視學校的數理教學，因此，在華人地區中小學的科學教育不但是教育改革的核心，在策略上更可善加運用，使其成為帶動學校整體教育改革的主力。以往的研究結果顯示，教師在科學教育改革中扮演至關緊要的角色。近二、三十年來，在科學教育研究領域中對於有效的學習、數理教學的原理、數理師資培育和教師專業發展原則等，在理論上已有相當深入的了解。本文將引述相關文獻，介紹晚近科學教育在這方面的進展，尤其是從強調數理教師教學實務知識的本質與發展，說明在數理教學與師資培育上面如何加強理論和實務的連結，藉以提昇數理教師專業能力和學生學習成效。

Invited Speakers 小組演講嘉賓

Invited Speaker 3:

Dr. May CHENG May Hung (鄭美紅博士)
Reader in Professional Education, Department of Education,
University of Oxford, UK
Tuesday, 21 December 2010, 13:15-14:00, D1-LP-04

Science education research which matters

Abstract

There are education reforms which have redefined teaching pedagogy in science classrooms and the values of science learning in recent years. Similar to other education reform initiatives, there are concerns about the lack of impact these initiatives are having at the classroom level. The question for researchers is thus to identify our roles in these reform initiatives. I would like to invite the audience to consider three different types of science education research, namely that in which researchers reveal an overview of the situation, that in which researchers facilitate changes in school practices, and that which engages science teachers in action research with an aim to refining practice. The discussion is illustrated by research initiatives in science assessment in Hong Kong. The endeavour of the Hong Kong curriculum reform in implementing alternative assessment in science sets the context. The first type of research is exemplified by findings on teachers' views in two survey studies. A university-school project which supports local secondary schools to implement authentic assessment which takes the form of scientific investigations is drawn as an example for the second type of research. The follow-up project which tests out a two phased model to support students in conducting scientific investigation tasks provides an illustration of the third type of research. The impact on science pedagogy and issues accompanying the three types of research are analysed. Finally, I will explore with the audience the types of research which are crucial to effect changes at the science classroom level, and invite a reflection on whether and how the different types of research may play a complementary role.

Invited Speakers 小組演講嘉賓

Invited Speaker 4:

Dr. STIMPSON Philip G.
Associate Professor (retired), Policy, Administrating and Social Sciences Education (PASSE) Division, Faculty of Education,
The University of Hong Kong
Tuesday, 21 December 2010, 14:00-14:45, D1-LP-04

ESD and teacher education: Dilemmas and directions

Abstract

While there has been much discussion in the literature regarding education for sustainable development (ESD) and its forerunner, environmental education, in schools, there has been far less within teacher education. It has become something of a secret world. ESD is rarely central to schools' core curricula and thus it is not surprising that it is on the margins of Teacher Education despite exhortations of UN agencies for capacity building initiatives. Teacher education in support of ESD often seems ad hoc and the commitment and enthusiasm of individuals greater than that of institutions and higher education systems. Answering key interrelated questions of What, When, Where, How and By Whom raise serious dilemmas that need to be addressed if teachers of ESD are to be supported in an effective and sustained manner across education systems as a whole. Approaches to teacher education required for ESD often do not fit easily within the mainstream yet accommodation is essential. The paper discusses the tensions that seem apparent and offers some directions for the future.

Conference Programme Outline 會議程序表概要

Day 1 (Monday, 20 December 2010) 首日(2010 年 12 月 20 日，星期一)

Time (時間)	Programme (程序)	Venue (地點)
08:30 – 09:00	Registration (大會登記)	Outside area of Room C-LP-11
09:00 – 10:00	Opening Ceremony (開幕典禮)	D1-LP-04
10:00 – 11:00	Keynote Address 1 (主題演講 1)	D1-LP-04
11:00 – 11:15	Morning Tea Break (茶點招待)	Learning Common
11:15 – 12:00	Workshop (工作坊 1#, 2 及 3)	Room 8, 4, 9
12:00 – 13:15	Lunch (午膳)	Canteen - The Cove View (彥膳坊)
	Poster Session 1 (海報展覽發表 1)	Outside area of Room D1-LP-02
	Hong Kong Educational Research Association - Annual General Meeting (香港教育研究學會 – 週年大會)	Block E
13:15 – 14:00	Invited Speech 1 (特邀講座 1)	D1-LP-04
	Workshop 4 & 5# (工作坊 4 & 5#)	Room 4, 8
14:00 – 14:45	Workshop 5#, 6, 7 & 8 (工作坊 5#, 6, 7 及 8)	Room 8, 3, 4, 5
14:45 – 15:45	Parallel Session 1 (分組論文報告 1)	Room 1-7
15:45 – 16:00	Afternoon Tea Break (茶點招待)	Learning Common
16:00 – 17:00	Parallel Session 2, Symposium 1 & 2 (分組論文報告 2, 專題研討會 1 及 2)	Room 1-6
17:00 – 18:00	Parallel Session 3, Symposium 1 & 2 (分組論文報告 3, 專題研討會 1 及 2)	Room 1-6
19:00 – 21:00	Conference Dinner (大會晚宴)	HK Science Park

Day 2 (Tuesday, 21 December 2010) 次日(2010 年 12 月 21 日，星期二)

Time (時間)	Programme (程序)	Venue (地點)
09:00 – 10:00	Keynote Address 2 (主題演講 2)	D1-LP-04
10:00 – 10:45	Invited Speech 2 (特邀講座 2)	D1-LP-04
	Workshop 9 & 10 (工作坊 9 & 10)	Room 3, 4
10:45 – 11:00	Morning Tea Break (茶點招待)	Learning Common
11:00 – 12:00	Parallel Session 4 (分組論文報告 4)	Room 1-6
12:00 – 13:15	Lunch (午膳)	Canteen - The Cove View (彥膳坊)
	Poster Session 2 (海報展覽發表 2)	Outside area of Room D1-LP-02
13:15 – 14:00	Invited Speech 3 (特邀講座 3)	D1-LP-04
	Workshop 11 & 12 (工作坊 11 及 12)	Room 3, 4
14:00 – 14:45	Invited Speech 4 (特邀講座 4)	D1-LP-04
	Workshop 12 & 13 (工作坊 12 及 13)	Room 4, 5
14:45 – 15:00	Afternoon Tea Break (茶點招待)	Learning Common
15:00 – 16:00	Parallel Session 5 & Symposium 3 (分組論文報告 5 及 專題研討會 3)	Room 1-6
16:00 – 17:00	Parallel Session 6 & Symposium 4 (分組論文報告 6 及 專題研討會 4)	Room 1-6
17:00 – 17:45	Closing Ceremony	D1-LP-04

Conference Programme Details 會議程序表細節

Day 1 (Monday, 20 December 2010) 首日(2010 年 12 月 20 日，星期一)		
08:30 – 09:00	**Registration (大會登記)**	**Outside area of Room C-LP-11**
09:00 – 10:00	**Opening Ceremony (開幕典禮)** **Speech by Chairs of GCCSE 2010** **Speech by Mrs. Rita FAN Hsu Lai Tai (范徐麗泰女士)** **Speech by Prof. Joshua MOK Ka Ho (莫家豪教授)**	**D1-LP-04**
10:00 – 11:00	**Keynote Address 1 (主題演講 1)** **Prof. LINN Marcia**, University of California, Berkeley Title: Visualizing science: Using technology to promote knowledge integration	**D1-LP-04**
11:00 – 11:15	**Morning Tea Break (茶點招待)**	**Learning Common**
11:15 – 12:00	**Workshop 1# (工作坊 1#)** **鄺偉良先生、黃志堅先生、張錦華先生 (香港數理教育學會)** Title: 香港理科教師在新高中課程遇到的挑戰與機遇	**Room 8: D2-LP-12**
	Workshop 2 (工作坊 2) **陳勇輝博士，楊玉枝女士 (台灣國立海洋生物博物館)** 題目: 教育功能與角色	**Room 4: D1-LP-06**
	Workshop 3 (工作坊 3) **Dr. SHEN Ji and Dr. CHANG Hsin-Yi** Title: Designing effective embedded assessments in technology-enhanced science curricula	**Room 9: D4-LP-02**
12:00 – 13:15	**Lunch (午膳)**	**Canteen - The Cove View (彥膳坊)**
	Poster Session 1 (海報展覽發表 1)	**Outside area of Room D1-LP-02**
	Hong Kong Educational Research Association Annual General Meeting (香港教育研究學會 – 週年大會)	**Block E**
13:15 – 14:00	**Invited Speech 1 (特邀講座 1)** **Prof. CAI Tie Quan (蔡鐵權教授)** , Zhejiang Normal University 題目:中國(大陸地區)科學教育的研究與發展	**D1-LP-04**
	Workshop 4 (工作坊 4) **Mr. Byron LI (WWF – Hong Kong) (世界自然基金會香港分會)** Title: How to use innovation e-learning and mobile learning technologies for conducting environmental education programmes at remarkable ecological hot spots in Hong Kong	**Room 4: D1-LP-06**
	Workshop 5# (工作坊 5#) **鄭慕賢博士** 題目: 如何成為一名有創意的教師	**Room 8: D2-LP-12**

Day 1 (Monday, 20 December 2010) 首日(2010 年 12 月 20 日，星期一)		
14:00 – 14:45	**Workshop 5# (工作坊 5#)** **鄭慕賢博士** 題目: 如何成為一名有創意的教師	**Room 8: D2-LP-12**
	Workshop 6 (工作坊 6) **Mr. PAU Chiu-Wah, Mr. MAK Hon Lung** **Hong Kong Examinations and Assessment Authority (香港考試及評核局)** Title: Assessment of science subjects in public examinations in Hong Kong: Entering a New Era in 2012	**Room 3: D2-LP-10**
	Workshop 7 (工作坊 7) **GreenPeace (綠色和平)** Title: Applying science in environment protection to achieve positive changes in equity	**Room 4: D1-LP-06**
	Workshop 8 (工作坊 8) **Eco-Education & Resources Centre** Title: Escape from classroom - Outdoor education programmes	**Room 5: D1-LP-07**
14:45 – 15:45	**Parallel Session 1 (分組論文報告 1)**	

Parallel Session 1A - ICT in Science Education(科學教育與科技)

	Ref. Code	Seq.	Paper Title	Presenter	Region
December 20 14:45 – 15:45 Room 1: D2-LP-08	142	1	遠距視訊協同教學環境下中學學生知覺教學與學習感受之研究	余安順, 何信權, 施昆易, 王國華	TW
	220	2	「學習角落」的守門人-以「個人化課後輔導系統」探討線上教學助理與學生學習之研究	吳意真, 楊淑晴	TW
	341	3	提昇資訊倫理論述品質之研究：採用非同步論壇	*劉建人	TW

Parallel Session 1B - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)

	Ref. Code	Seq.	Paper Title	Presenter	Region
December 20 14:45 – 15:45 Room 2: D2-LP-09	157	1	小學自然教師的專業發展--以台灣臺北縣國小自然科輔導員實務經驗為例	鄭旭泰, 連啟瑞	TW
	222	2	中學生物學科實施探究式教學的實踐研究	岑芳	CN
	365	3	運用現象學方法探究理科生學習體驗及促進教師專業發展	*吳本韓, 高潔, 趙遠棋, 李樹英	HK

Parallel Session 1C - Development of Science Curriculum (科學課程發展)

	Ref. Code	Seq.	Paper Title	Presenter	Region
December 20 14:45 – 15:45 Room 3: D2-LP-10	272	1	中外籍教師共同發展全球能源議題雙語課程初探：以後設認知策略進行英語村科學館環境教育為例	鍾千昭, 洪振方, 鍾一哲	TW
	270	2	國小學童奈米科學營學習成效之研究	吳坤璋, 謝佩妤, 黃台珠, 陳東煌, 卓宴榆, 羅茂彰, 程重鳴	TW
	305	3	小學科學概念教學存在的問題及其對策	*鄭雪萍	CN

Parallel Session 1D - Learning and Teaching Science (科學教學策略)

	Ref. Code	Seq.	Paper Title	Presenter	Region
December 20 14:45 – 15:45 Room 4: D1-LP-06	250	1	In search of a framework to facilitate statements of definitions in Physics: Is Feynman's Lectures on Physics a good guide?	WONG Chee Leong, YAP Kueh Chin	SG
	369	2	The effects of a facilitator on the performance of a heterogeneous working group in science and technology education	LI Shing Sun	HK
	320	3	An insight into bioethics education in high schools in Singapore	*HOH Yin Kiong	SG

Day 1 (Monday, 20 December 2010) 首日(2010 年 12 月 20 日，星期一)					
Parallel Session 1E – Assessment of Students' Science Learning and Development (學生科學學習與發展的評估)					
December 20 14:45 – 15:45 Room 5: D1-LP-07	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	140	1	提升高中女生對化學課態度的實證研究	楊潔, 張善培	HK
	158	2	以腦波研究法探討大學生 3D 化學結構式辨識之差異	黃琴扉, 劉寶元, 劉嘉茹	TW
	108	3	國小五年級科學史融入天文教學之研究	*賴慶三, 吳盈妮	TW
Parallel Session 1F – Historical, Philosophical, Social, Cultural, and Gender Issues (與科學教育有關的歷史、哲學、社會、文化和性別事宜)					
December 20 14:45 – 15:45 Room 6: D1-LP-08	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	88	1	高中物理教科書評價指標體系的國際比較研究	鄧磊	CN
	213	2	兩篇「能量塔」文本之比較分析研究	葉佳承, 楊文金	TW
	236	3	技專生對專業化學課程與日常化學事物的學習態度之研究	*丁信中	TW
Parallel Session 1G – Science Education in Taiwan (台灣的科學教育)					
December 20 14:45 – 15:45 Room 7: D2-LP-05	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	155	1	An exploration of aboriginal secondary boys' and girls' learning interests and learning in science	HONG Zuway-R, YU Tien-Chi, CHIANG Wei-Hao, CHENG Mei-Shui	TW
	195	2	國小男女學生在「能源與運輸工具」之實務研究	林容妃, 賴慶三	TW
	177	3	朝向小學教師科學教學知識增能的專業合作探究取向	*熊召弟, 熊同鑫, 林胤彤	TW
15:45 – 16:00	**Afternoon Tea Break (茶點招待)**				
16:00 – 17:00	**Parallel Session 2, Symposium 1 & 2 (分組論文報告 2, 專題研討會 1 及 2)**				
Parallel Session 2A - ICT in Science Education(科學教育與科技)					
December 20 16:00 – 17:00 Room 1: D2-LP-08	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	291	1	「科學知識」與「科學資訊來源」對大學生擬科學態度影響之研究	謝佩妤, 蘇懿生, 黃台珠	TW
	259	2	應用個人回饋系統在資訊安全素養課程之運用	林凱胤, 林宇健	TW
	307	3	提昇資訊倫理論述品質之研究：採用非同步論壇	*鄭雪萍	CN
Parallel Session 2B - Learning and Teaching Science (科學教學策略)					
December 20 16:00 – 17:00 Room 2: D2-LP-09	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	151	1	Teaching school science within the cognitive and affective domains	TAN Kok Siang, HENG Chong Yong, LIN Zi Kai, TAN Shu Hui	SG
	243	2	The use of small-group discussion, guiding questions and molecular models to teach molecular geometry and polarity	TEH Yun Ling	SG
	116	3	The investigation of Taiwanese elementary school students' self-efficacy and learning in science	*HONG Zuway-R, LIN Huann-Shyang, CHEN Hsiang-Ting, WANG Hsin-Hui, YANG Kuay-Keng	TW

Day 1 (Monday, 20 December 2010) 首日(2010 年 12 月 20 日，星期一)					
Parallel Session 2C – Science Education in Life-wide/Authentic/Informal Contexts (課外或全方位的科學教育)					
December 20 16:00 – 17:00 Room 3: D2-LP-10	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	107	1	國小五年級生物多樣性教學之研究	賴慶三, 許凱琳	TW
	278	2	探索學生對非制式奈米科學課程的學習興趣	鄭瑞洲, 黃台珠, 卓宴榆, 羅茂彰, 程重鳴	TW
	296	3	社會公民氣象媒體素養	*古智雄, 蔡易輯	TW
Parallel Session 2D – Historical, Philosophical, Social, Cultural, and Gender Issues (與科學教育有關的歷史、哲學、社會、文化和性別事宜)					
December 20 16:00 – 17:00 Room 4: D1-LP-06	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	228	1	科學論述中文言到白話過度之研究—以牛頓第一運動定律為例	范賢娟, 楊文金	TW
	172	2	國小高年級學童颱風現象概念問卷之研究	黃皇明, 全中平	TW
	371	3	澳門中學科學教學: 問題與挑戰	*魏冰	MO
Symposium 1 - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)					
December 20 16:00 – 17:00 Room 5: D1-LP-07	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	332	/	Preparing teachers for teaching nature of science: A video-based approach	YUNG Hin Wai, WONG Siu Ling, YIP Wing Yan, LAI Ching, LO Man Sum, LIE Ho Yin	HK
Symposium 2 - Development of Science Curriculum (科學課程發展)					
December 20 16:00 – 17:00 Room 6: D1-LP-08	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	340	/	Curriculum reform and restructuring of senior secondary education in Hong Kong: Perceived challenges and implications	CHENG Nga Yee, LAM Chi Chung, YEUNG Yau Yuen, LEE Yeung Chun, LAM Chung Man	HK
17:00 – 18:00	**Parallel Session 3, Symposium 1 & 2 (分組論文報告 3, 專題研討會 1 及 2)**				
Parallel Session 3A - ICT in Science Education(科學教育與科技)					
December 20 17:00 – 18:00 Room 1: D2-LP-08	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	327	1	Online resource-based learning environment: Case studies in primary classrooms	SO Wing Mui, CHING Ngai Ying	HK
	297	2	Applying blogs for pre-service teachers in science education: From one's epistemology towards a pragmatic approach in collaborative and ubiquitous learning	CHUI Hin Leung, TSANG Po Keung	HK
	322	3	High school students' conceptual understandings and modeling practices in a computer-based modeling environment	*WU Hsin-Kai, HSU Ying-Shao, HWANG Fu-Kwun	TW
Parallel Session 3B - Learning and Teaching Science (科學教學策略)					
December 20 17:00 – 18:00 Room 2: D2-LP-09	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	153	1	創造性問題解決融入科學遊戲的教學行動研究-以「光」為例	許良榮, 蕭淑分, 謝亞芬	TW
	293	2	利用「動手做」活動探討國小學童對重力概念的理解差異	陳燕嬋, 劉嘉茹	TW
	372	3	Exploring children' understanding of the ecological concepts and its implication for environmental education	*TSOI Kwok Ho	HK

Day 1 (Monday, 20 December 2010) 首日(2010 年 12 月 20 日，星期一)					
Parallel Session 3C – Science Education in Life-wide/Authentic/Informal Contexts (課外或全方位的科學教育)					
	Ref. Code	**Seq.**	**Paper Title**	**Presenter**	**Region**
December 20 **17:00 – 18:00** **Room 3:** **D2-LP-10**	254	1	動物園生物多樣性教學對國小五年級學童學習影響之研究	施春輝, 賴慶三	TW
	233	2	他們像科學家嗎？高中學生於新興科技探究課程之探究能力表現的個案研究	陳毓凱, 洪振方	TW
	256	3	從科學新聞到公民意識-以科學傳播為基礎的課程發展及教學應用	*黃俊儒	TW
Parallel Session 3D – Assessment of Students' Science Learning and Development (學生科學學習與發展的評估)					
	Ref. Code	**Seq.**	**Paper Title**	**Presenter**	**Region**
December 20 **17:00 – 18:00** **Room 4:** **D1-LP-06**	202	1	診斷原住民學生對科學文本「葉的構造與功能」之閱讀困難研究	廖斌吟, 楊文金, 葉佳承, 黃柏森	TW
	289	2	台灣科技校院學生對科學相關議題態度之研究	曾元玨, 蔡俊彥, 黃台珠	TW
	362	3	小學生科學課學習情況的調查和思考—以廣州市天河區為例	*高淩飆, 馮翠典, 鄭雪萍, 詹茂榮	CN
Symposium 1 - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)					
	Ref. Code	**Seq.**	**Paper Title**	**Presenter**	**Region**
December 20 **17:00 – 18:00** **Room 5:** **D1-LP-07**	332	/	Preparing teachers for teaching nature of science: A video-based approach	YUNG Hin Wai, WONG Siu Ling, YIP Wing Yan, LAI Ching, LO Man Sum, LIE Ho Yin	HK
Symposium 2 - Development of Science Curriculum (科學課程發展)					
	Ref. Code	**Seq.**	**Paper Title**	**Presenter**	**Region**
December 20 **17:00 – 18:00** **Room 6:** **D1-LP-08**	340	/	Curriculum reform and restructuring of senior secondary education in Hong Kong: Perceived challenges and implications	CHENG Nga Yee, LAM Chi Chung, YEUNG Yau Yuen, LEE Yeung Chun, LAM Chung Man	HK
19:00 –21:00	**Conference Dinner (大會晚宴)** **Hong Kong Science Park – Happiness Cuisine (囍慶盛讌)**				

*Chair of Parallel Session (演講報告主席)

#Total number of participants is limited to 30-35. Seat allocation will be made on a first-come-first-served basis. (參加人數名額為 30-35 人。席位名額是以先到先得方式分配。)

CN = China (中國)
HK = Hong Kong (香港)
MO = Macau (澳門)
SG = Singapore (新加坡)
TW = Taiwan (台灣)

Day 2 (Tuesday, 21 December 2010) 次日(2010 年 12 月 21 日，星期二)		
09:00 – 10:00	**Keynote Address 2 (主題演講 2)** **Prof. SJØBERG Svein**, University of Oslo Title: Young people, science and technology: What survey research tells us about attitudes, interests, values and future plans	**D1-LP-04**
10:00 – 10:45	**Invited Speech 2 (特邀講座 2)** **Prof. GUO Ghrong Jee (郭重吉教授)**, National Changhua University of Education Title: 亞洲華人地區數理教學與師資培育的挑戰與機會	**D1-LP-04**
	Workshop 9 (工作坊 9) **Association for Geoconservation, Hong Kong (香港地貌岩石保育協會)** Title: Roles of NGO in popularizing geosciences	**Room 3: D2-LP-10**
	Workshop 10 (工作坊 10) **Mr. WONG Shek Nin, Aberdeen Technical School** Title: Promoting students' scientific attitude through informal contexts: From local to national	**Room 4: D1-LP-06**
10:45 – 11:00	**Morning Tea Break (茶點招待)**	**Learning Common**
11:00 – 12:00	**Parallel Session 4 (分組論文報告 4)**	

Parallel Session 4A - ICT in Science Education(科學教育與科技)

	Ref. Code	Seq.	Paper Title	Presenter	Region
December 21 11:00 – 12:00 Room 1: D2-LP-08	204	1	實物實驗與虛擬實驗促進學生科學探究能力之研究	蔡錕承, 張欣怡	TW
	205	2	國小自然與生活科技領域電子教科書融入教學之實施現況研究	彭文萱, 熊召弟	TW
	304	3	計算機輔助物理實驗的低成本設計及教學實踐研究	*吳肖, 周少娜, 楊友源	CN

Parallel Session 4B - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)

	Ref. Code	Seq.	Paper Title	Presenter	Region
December 21 11:00 – 12:00 Room 2: D2-LP-09	135	1	探尋促進北京郊區初中物理教師專業發展的有效途徑	盧慕稚	CN
	179	2	美麗的塑膠花--打開自然領域輔導教教師心靈之行動研究	王純姬	TW
	170	3	台灣原住民地區國小科學教師多元文觀點之專業發展	*李暉	TW

Parallel Session 4C - Development of Science Curriculum (科學課程發展)

	Ref. Code	Seq.	Paper Title	Presenter	Region
December 21 11:00 – 12:00 Room 3: D2-LP-10	94	1	台灣離島奈米教育推廣案例探討	林仁輝, 陳錫添, 林弘萍, 黃台珠	TW
	208	2	中國內地的科學技術教育與科學課程改革---------基於可持續發展的理念	楊寶山	CN
	231	3	台灣 K-12 奈米科技教育課程指標之建構歷程	*熊召弟, 趙毓圻	TW

Parallel Session 4D - Learning and Teaching Science (科學教學策略)

	Ref. Code	Seq.	Paper Title	Presenter	Region
December 21 11:00 – 12:00 Room 4: D1-LP-06	337	1	Wiki 在教育方面的應用研究	盧德元	CN
	167	2	以臆測為中心的數學寫作活動對學生數學素養影響歷程之研究	秦爾聰, 賴紀寧	TW
	235	3	學生在科學探究中的思維方式研究	*鐘媚	CN

Day 2 (Tuesday, 21 December 2010) 次日(2010 年 12 月 21 日，星期二)					
Parallel Session 4E – Science Education in Life-wide/Authentic/Informal Contexts (課外或全方位的科學教育)					
	Ref. Code	**Seq.**	**Paper Title**	**Presenter**	**Region**
December 21 11:00 – 12:00 **Room 5: D1-LP-07**	104	1	The application of community service learning on higher science education	NG Ling Ling Betsy, YAP Kueh Chin, HOH Yin Kiong	SG
	149	2	Development of a Parent's Guide for the Singapore Primary Science Curriculum: Empowering parents as facilitators of their children's science learning outside the formal classrooms	LEE Ai Noi	SG
	345	3	Spatial ability in understanding astronomy concepts	*KWOK Ping Wai	HK
Parallel Session 4F – Assessment of Students' Science Learning and Development (學生科學學習與發展的評估)					
December 21 11:00 – 12:00 **Room 6: D1-LP-08**	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	251	1	廣州市初中生物學科開放式考查的實践與探索	馬學軍	CN
	303	2	台灣五年級學童太陽系學習成效之分析研究	吳季玲	TW
	234	3	國中學生對「分為」一詞之語意理解	*楊文金, 范賢娟, 葉佳承, 李哲迪	TW
12:00 – 13:15	**Lunch & (午膳)**				**Canteen - The Cove View (彥膳坊)**
	Poster Session 2 (海報展覽發表 2)				**Outside area of Room D1-LP-02**
13:15 – 14:00	**Invited Speech 3 (特邀講座 3)** **Dr. CHENG May Hung May**, University of Oxford Title: Science education research which matters				**D1-LP-04**
	Workshop 11 (工作坊 11) **Mr. LAU Sai Chong, Lingnan Dr. Chung Wing Kwong Memorial Secondary School** Title: Innovative technology creates a new world record				**Room 3: D2-LP-10**
	Workshop 12 (工作坊 12) **Prof. Benny YUNG Hin Wai** Title: Making use of students' prior ideas to teach nature of science				**Room 4: D1-LP-06**
14:00 – 14:45	**Invited Speech 4 (特邀講座 4)** **Dr. STIMPSON Philip**, The University of Hong Kong Title: ESD and teacher education: Dilemmas and directions				**D1-LP-04**
	Workshop 12 (工作坊 12) **Prof. Benny YUNG Hin Wai** Title: Making use of students' prior ideas to teach nature of science				**Room 4: D1-LP-06**
	Workshop 13 (工作坊 13) **Dr. Jimmy WONG Kam Yiu, Hong Kong New Generation Cultural Association Science Innovation Centre** Title: In search of innovative talents				**Room 5: D1-LP-07**
14:45 – 15:00	**Afternoon Tea Break (茶點招待)**				**Learning Common**
15:00 – 16:00	**Parallel Session 5 & Symposium 3 (分組論文報告 5 及 專題研討會 3)**				
Parallel Session 5A - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)					
December 21 15:00 – 16:00 **Room 1: D2-LP-08**	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	248	1	策劃專題研習及顧問老師領導的分享	周水英, 黃偉強, 賴子琪	HK
	176	2	回看臺灣科學教育師資培育體系：三位資深科學教育師資培育工作者訪談分析	熊同鑫, 楊書毓	TW
	349	3	浙江省科學教師與學生的科學本質觀之調查與層因分析	*黃曉	CN

Day 2 (Tuesday, 21 December 2010) 次日(2010 年 12 月 21 日，星期二)					
Parallel Session 5B - Learning and Teaching Science (科學教學策略)					
December 21 15:00 – 16:00 Room 2: D2-LP-09	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	136	1	小學科學探究式教學的八個環節的提出	孟令紅	CN
	199	2	臆測為中心之數學教學活動設計—以數列與級數為例	秦爾聰, 簡大為, 李立凱	TW
	328	3	創造性科學問題提出能力的發展及影響研究	*韓琴	CN
Parallel Session 5C – Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)					
December 21 15:00 – 16:00 Room 3: D2-LP-10	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	348	1	An preliminary investigation into critical thinking of in-service and pre-service middle school chemistry teachers in Shaanxi province of China	ZHOU Qing, XING Li Juan, WANG Yan	CN
	358	2	A descriptive study of three pre-service teachers' understanding and practice of argumentation in science classroom	XIE Qun, SO Wing Mui	CN
	367	3	The design and implementation of elementary science methods class instruction in the U.S. Colleges and Universities	*LEE Carole	US
Parallel Session 5D - Historical, Philosophical, Social, Cultural, and Gender Issues (與科學教育有關的歷史、哲學、社會、文化和性別事宜)					
December 21 15:00 – 16:00 Room 4: D1-LP-06	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	356	1	近十年國外科學教育中 HPS 教育研究的文獻計量學分析 - 以 Science & Education 為例	林長春, 杜紅	CN
	124	2	因果解釋在科學教科書中的取向—以牛頓力學與演化論為例	*蔣佳玲	TW
Parallel Session 5E – Assessment of Students' Science Learning and Development (學生科學學習與發展的評估)					
December 21 15:00 – 16:00 Room 5: D1-LP-07	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	203	1	Development of an instrument for measuring elementary students' science oral expression	LIN Sheau-Wen, LIU Yu, CHEN Shin-Feng, WANG Jing-Ru, KAO Huey-Lien	TW
	225	2	Meta-analysis of effects of inquiry teaching on student learning	WANG Jing Ru, HUANG Bao-Yuan, TSAY Reuy-Fen, LEE Kuo-Ping, LIN Sheau-Wen, KAO Huey-Lien	TW
	240	3	Toward establishment of a "fair" assessment system: An analysis of alignment between standardized exams and the national curriculum standards	*LIANG Ling, CHEN Xian, MA Hong Jia, FULMER Gavin	US
Symposium 3 - ICT in Science Education(科學教育與科技)					
December 21 15:00 – 16:00 Room 6: D1-LP-08	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	313	/	電子學習 2.0：常識科的學與教	蘇詠梅, 詹文通, 羅玉婷, 趙崇基, 林蘭芳	HK

Day 2 (Tuesday, 21 December 2010) 次日(2010 年 12 月 21 日，星期二)					
16:00 – 17:00	**Parallel Session 6, Symposium 4 (分組論文報告 6 及 專題研討會 4)**				
Parallel Session 6A - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)					
December 21 16:00 – 17:00 Room 1: D2-LP-08	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	211	1	職前教師設計與評論動態表徵融入科學課程之研究	黃昭仁, 張欣怡	TW
	287	2	新疆維吾爾自治區職前理科教師"科學探究知識"調查研究	*李玉峰	CN
Parallel Session 6B - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)					
December 21 16:00 – 17:00 Room 2: D2-LP-09	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	249	1	Development of pedagogical content knowledge for teaching nature of science : A case study of prospective biology teachers	LO Man Sum	HK
	353	2	The preservice science teacher education program in new science curriculum of Mainland China：From the pedagogical perspective	HUANG Dao Ming, XIAO Hua	CN
	333	3	Mentoring for masters students as prospective science teachers: A case study in Mainland China	*DING Bang Ping	CN
Parallel Session 6C - Learning and Teaching Science (科學教學策略)					
December 21 16:00 – 17:00 Room 3: D2-LP-10	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	290	1	結合繪本與「動手做」遊戲教學法對學齡前幼兒科學學習的影響	周珮涵, 劉嘉茹	TW
	267	2	統整科學與語文敘事課程教學設計與分析	黃孝宗, 黃台珠	TW
	352	3	《科學技術概論》課程資源的開發與利用	*卞祖武	CN
Parallel Session 6D - Learning and Teaching Science (科學教學策略)					
December 21 16:00 – 17:00 Room 4: D1-LP-06	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	125	1	淺談新課程改革下教師使用教材的誤區及創造性使用教材的建議	高勍	CN
	133	2	類比學習環對八年級學生浮力概念改變之影響	*林建隆, 徐順益	TW
Parallel Session 6E - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)					
December 21 16:00 – 17:00 Room 5: D1-LP-07	**Ref. Code**	**Seq.**	**Paper Title**	**Presenter**	**Region**
	347	1	Identifying souses of stress among high school chemistry teachers at Shaanxi province in China	ZHOU Qing, LIU Ya Zhuan, ZENG Yu Gui	CN
	132	2	The study of how science teachers promote professional knowledge in instructing primary science fair	LU Chow-Chin, CHEN Chung-Yu	TW
	105	3	The influence of Marxism on Chinese science teacher educators' conceptions of Nature of Science to be taught to prospective science teachers	*WAN Zhi Hong, WONG Siu Ling	HK

Day 2 (Tuesday, 21 December 2010) 次日(2010 年 12 月 21 日，星期二)					
Symposium 4 – Learning and Thinking Electrical Power					
	Ref. Code	**Seq.**	**Paper Title**	**Presenter**	**Region**
December 21 **16:00 – 17:00** **Room 6:** **D1-LP-08**	260	1	Facilitating learning and thinking electrical power through a divergent Task	YAP Kueh Chin, CHIA Kok Pin, TAN Peck Har	SG
	261	2	A quantitative study of students' understanding of electrical power	CHIA Kok Pin, TAN Peck Har, YAP Kueh Chin	SG
	262	3	A qualitative study of students' alternative conceptions on electrical power	*TAN Peck Har, YAP Kueh Chin, CHIA Kok Pin	SG
17:00 – 17:45	**Closing Ceremony** **Speech by Prof. Joshua MOK Ka Ho (莫家豪教授)**				**D1-LP-04**

*Chair of Parallel Session (演講報告主席)
#Total number of participants is limited to 30-35. Seat allocation will be made on a first-come-first-served basis. (參加人數名額為 30-35 人。席位名額是以先到先得方式分配。)

CN = China (中國)
HK = Hong Kong (香港)
MO = Macau (澳門)
SG = Singapore (新加坡)
TW = Taiwan (台灣)

Parallel Session – Abstract of Papers (分組論文報告–論文摘要)

Parallel Session 1A - ICT in Science Education(科學教育與科技)

Date: 20 December 2010 (Monday)
Time: 14:45 - 15:45
Room 1: D2-LP-08

1A – 1 (142) 遠距視訊協同教學環境下中學學生知覺教學與學習感受之研究

作者: 余安順, 何信權, 施昆易, 王國華, 台灣

本研究是在一個同步的遠距視訊環境下，以一位化學教師進行 冷縮熱脹單元的液態氮實驗演示搭配兩位元生物教師班級的協同教學。為了支援生物教師在理化科目教學時實驗設備與學科教學經驗的不足，因此以遠距視訊協同教學 的方式進行化學實驗。目的在於瞭解遠距協同環境中，以教師教學專業互補的形式進行協同之下，學生對教師的學科教學知覺與學習感受。本研究以參與遠距協同的 兩個班級共 71 名學生為研究對象，透過問卷調查法收集學生對教師的教學知覺問卷（SPOTK）與學習感受問卷。研究結果顯示學生在遠距視訊協同環境下，對於教師的教學策略知覺上有達到顯著差異，對於遠距協同的方式，在學習感受上也呈現中高度的接受度，而在協同教學的接受度上也達到顯著差異。

1A – 2 (220) 「學習角落」的守門人-以「個人化課後輔導系統」探討線上教學助理與學生學習之研究

作者: 吳意真, 楊淑晴,台灣

以學生為中心的網路教學，教學助理扮演老師與學生之間的橋樑。但以往研究大都探討學生透過線上文字尋求協助，很少探討學生透過線上面對面尋求協助，所以為瞭解學生在不同鷹架引導課後輔導模式(線上「文字」與線上「面對面」)的求助過程與學習情形，有下列兩項研究目的：

（一）探討線上教學助理不同的鷹架引導模式與學生自我調整學習、後設認知與學習成效是否有差異。

（二）剖析線上教學助理不同的鷹架引導模式在鷹架輔導策略上是否有差異。

本研究透過統計軟體將採用之量化工具：「學習成績」、「自我效能量表」、「個人成就目標量表」、「學習策略量表」、「自我調整量表」進行資料處理；並依據 Pintrich 在 2000 年提出的自我導向學習四個面向：活化(Activation)、反思(Reflection)、監督(Monitor)與控制 (Control) 觀察學生線上文字課後輔導的行為進行分類。

研究結果顯示自我導向學習與學生的學習成效與後設認知有相關；兩種鷹架引導模式除教學助理使用不同引導工具外，引導策略並沒有差異。未來可探討兩種鷹架模式的引導順序是否與學習成效與後設認知有關；與探討不同人格特質的線上教學助理所使用的鷹架引導策略。

1A – 3 (341) 提昇資訊倫理論述品質之研究：採用非同步論壇

作者: 劉建人, 台灣

本研究使用非同步論壇作為線上討論的工具，旨在瞭解學生對資訊倫理議題的論述情形與如何提昇論述品質。研究者根據 Bird 提出的 3C（Content-Construct-Consolidation）線上課程設計模式來設計課程，研究對象為大學四年級修習資訊倫理數位課程的 36 位學生，共分成七組，並於議題討論過程由教師及組長進行鷹架輔助，為了評估資訊倫理的論述的品質，於學期末根據 Garrison 等人提出的「實務探詢模型」，結合內容分析法來進行細部分析，並與教師反思資料互相比對。研究結果發現：「教學鷹架」與「議題設計」是提昇論述品質的關鍵因素，前者可以透過「提問」與「教導」的鷹架策略來達成；後者建議在設計個別討論議題時，應整合內容分析的模型來進行設計。

Parallel Session 1B - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)

Date: 20 December 2010 (Monday)
Time: 14:45 - 15:45
Room 2: D2-LP-09

1B – 1 (157) 小學自然教師的專業發展--以台灣臺北縣國小自然科輔導員實務經驗為例

作者: 鄭旭泰, 連啟瑞, 台灣

小學科學教育現場需要怎樣的專業發展方式來提升教學？本研究透過台灣臺北縣國小自然科輔導員參與專業發展促進社群的實務經驗瞭解：

1. 台灣的國小自然教學現況及問題，
2. 國小自然教師的專業發展需求，並進以輔導團專業發展成長模式，建議小學自然教師專業發展途徑

本研究之進行係由研究者透過檢視臺北縣教育局之九年一貫課程國教輔導團自然領域專案研究成果報告（臺北縣政府教育專案研究計畫臺北縣國小教師自然與生活科技領域教學知能現況調查研究 2009），以及分析輔導團分區輔導過程中所匯集之資訊，瞭解現場實務困境及需求，並在團務會議中進行統計分析、研商討論；省思研究者自身發展經驗，探討專業發展管道的優勢及難處，提出國小科學教師之專業成長研究成果及可行建議。

在台灣的自然科教學現場，困境需求依序為學科教學知識、課程知識、學科知識、專業成長、學校行政支援等，主要問題則在：科學相關科系教師教授國小自然學科的比例僅有三分之一，顯現學校教學專業知能尚有待提升，另外排課及職務編配和生態教學需求、設備等等，亦被認為應可再予強化。本研究亦發現國小多數在職進修以共同科目如：語文、輔導諮商等為主，國小科學教師主要進修管道有進修碩士學位、學分班、輔導團到校進行研習和教學較具關連性。

1B – 2 (222) 中學生物學科實施探究式教學的實踐研究

作者: 岑芳, 中國

縱觀近幾年中學生物教學現狀，高強度、大容量的機械訓練依然占很主要的位置。新課程宣導探究式學習，力圖轉變學生的學習方式，變被動接受式學習為主動探究式學習。如何實施探究式教學？教師需要在以往教學的基礎上繼承與創新，改進與完善。

本文從問題提出的背景出發，通過文獻研究法、調查研究法、行動研究法和經驗總結法，收集南京市生物學科實施探究式教學的實例，進行分類研究，分析存在的問題。在理論與實踐研究基礎上，提出探究式教學的實施原則，進行實踐，收集、分類新課程中探究式教學的實例，進行常態分析與總結，將實踐過程中積累的經驗上升為理論，在先進理論和成功經驗的指導下再進行教學實踐，初步形成有針對性指導教學實踐的策略。前後歷經 4 年研究過程，在課題組的教師參與下，從不同角度進行了多層次、全方位的研究與實驗，探索出新課程背景下實施探究性學習的方法、途徑、操作策略、評價方案、教師角色定位等，積累了許多成功的案例。在教學中推廣與運用，改善與優化了生物課堂教學的結構，轉變了學生的學習方式，為學生自主學習提供了活動空間，培養了學生的創新精神和實踐能力；通過課堂教學中探究式教學的實施，也提高了教師的教育教學技能。

1B – 3 (365) 運用現象學方法探究理科生學習體驗及促進教師專業發展

作者: 吳本韓, 高潔, 趙遠棋, 李樹英, 香港

學生對科學課的感受是什麼樣的，他們如何評價科學課中的教與學？這種感受與評價不是憑空臆想，而是源于學生在學習過程中的經驗和體悟。學生在上科學課的過程中會經歷無數的情境，不斷地影響他們的感受和學習。如果教師能知道學生的感受和想法，無疑會對學與教有更深入的瞭解，而最終得益者必定是學生。

本研究是參考范梅南（Van Manen, 1990, 1991）在研究教學機智（pedagogical tact）時所用的方法，通過運用現象學探究（phenomenological inquiry）及其解釋學探究（hermeneutic inquiry）來研究學生在科學課中的體驗。本研究首先搜集學生的生活體驗，將其最難忘的科學課情境以軼事的方式呈現出來，最後以焦點小組（focus group）的形式讓科學教師針對學生的生活體驗進行討論及反思，由此達到促進教師專業發展的目的。

是次報告會先解釋這項研究的理念及方法，並以數位香港中六學生提供的軼事作為示例，介紹在焦點小組討論中，科學教師作出哪些思考。

Parallel Session 1C - Development of Science Curriculum (科學課程發展)

Date: 20 December 2010 (Monday)
Time: 14:45 - 15:45
Room 3: D2-LP-10

1C – 1 (272) 中外籍教師共同發展全球能源議題雙語課程初探：以後設認知策略進行英語村科學館環境教育為例

作者: 鍾千昭, 洪振方, 鍾一哲, 台灣

Palmber（2000）認為環境教育隨著人或立場或時代或國情的不同，對於環境應保持何種狀態就有不同的想法。因此，身為全球公民的我們，應該瞭解全球不同國度的族群如何看待環境議題，對全球環境問題學習知識技能、採取適當的行動，進而關懷全球環境。Flavell (2002)指出後設認知策略能擴展學生高層次的思考；McGregor (2007)也發現後設認知策略能提點學生反思自己如何解決困境，所以，本研究以後設認知策略為教學鷹架，由中、外籍教師共同發展全球能源議題雙語課程，以進行英語村的環境教育。

本研究由一位加拿大籍外籍教師、一位紐西蘭籍外籍教師及二位本籍教師共同發展課程，並以高雄縣國際英語村旗山村為教學研究場域，從中、外籍教師進行全球能源議題教學活動的過程中，以行動研究的模式，依教學現況逐步調整發展課程。資料蒐集包含：教學觀察、教師省思劄記、教學對談記錄等，並進行質性綜合性比較及三角檢證。研究結果發現：課程中的腳踏車發電機，能讓學生親身體驗以瞭解動能換成為電能的過程；接著，課程中的後設認知策略教學鷹架，能使學生將科學知識遷移至各國不同的能源轉換過程中；最重要的是，中、外籍教師在發展課程的互動過程中，真實地共同面對環境變遷的能源議題。

1C – 2 (270) 國小學童奈米科學營學習成效之研究

作者: 吳坤璋, 謝佩妤, 黃台珠, 陳東煌, 卓宴榆, 羅茂彰, 程重鳴,台灣

本研究旨在探討國小學童在實施奈米科技教育實驗課程的「奈米科技概念」及「奈米科技課程興趣」的學習成效。奈米課程內容共分為奈米洗禮、蓮葉效應、奈米表 面、奈米碳球碳管、奈米磁導航等五單元，藉由多媒體教材引導師生討論奈米科技議題，透過分組操作實驗以對奈米科技進一步體察。102 位受試者在接受實驗課 程前後，皆進行「奈米科技概念問卷」前後測，剔除 3 份回答不完整之問卷後，所得 99 份資料以相依樣本 t 檢定、百分比同質性卡方檢定和積差相關等統計方法進行分析。研究結果發現：一、學童在奈米洗禮、蓮葉效應、奈米表面…等五個單元概念面向的前後測得分差異，皆達統計顯著水準（M 前測=3.18，M 後測=8.35，t=27.46，p< .001），顯見本研究所實施課程對學童的奈米科技概念具有學習成效。二、對於學校自然課有不同興趣的學童在實驗課程之後，對於奈米科技課程興趣有所差異（$\chi 2 = 12.31$，p< .01），大多數學生持有正面積極態度（對奈米課程有興趣的比率分別是 96%、71%）。三、學童的奈米科技概念及課程興趣之間的表現為顯著正相關（r= .34，p< .01），因此在推行奈米科技教育時，學生的奈米科技知識提升與課程設計的有效實施有關。最後，依據研究結果提出奈米科技教育的後續課程設計建議，例如強化奈米科技知識，結合創意產品設計課程，以落實奈米科技的實務應用。

1C – 3 (305) 小學科學概念教學存在的問題及其對策

作者: 鄭雪萍, 中國

科學概念是自然科學知識構成的最基本的要素，科學知識的推衍、規則的建立都離不開科學概念，正如鬱波所說的：獲得重要的和可遷移的觀念（科學概念），參能適應知識膨脹和複雜的環境。在小學科學課中有很多的科學概念，所以在科學教學中引導學生科學概念的建構是非常重要的。

本研究主要通過下校聽課，積累案例，並對案例進行分析。通過分析發現教師在科學概念教學存在三個問題。一是教師沒有關注學生的前科學概念。學生的前概念可能是正確的，也可能是錯誤的。如果教師不瞭解學生的前科學概念，很難引導學生建立起科學概念。二是教師往往忽視讓學生解釋觀察到的現象（獲取實事）。在獲取事實這個環節中教師往往注重學生動手做，忽略學生對觀察到的現象進行解釋。三是老師忽視引導學生把感性認識通過抽象概括上升到理性的認識，從而建構起科學概念。

綜上所述，要學生建立起科學概念，必須關注學生的前科學概念；必須引導學生獲取實事材料，必須引導學生對事實材料進行分析歸納概括，一步步建立起科學概念。這要求老師要"深入到學生的頭腦，看他們是如何建構資訊的，並把豐富的知識與創造的靈活性聯結起來，以多種方式構建和重新構建教材，傳授知識，深入孩子們的頭腦，傾聽他們的解釋和回答，對他們的思維方式和言語時刻保持注意"。那在教學中如何指導學生建立科學概念呢？下面給些建議。（一）老師要明白什麼是科學概念和前概念；（二）創設問題情景，引導猜想，充分地暴露學生的前概念。（三）通過用觀察、實驗等活動讓學生獲取實事，與原有知識聯繫形成新的認識。（四）引導學生整理加工事實，抽象概括出科學概念。（五）為新概念的形成提供鞏固和系統化的機會。

Parallel Session 1D - Learning and Teaching Science (科學教學策略)

Date: 20 December 2010 (Monday)
Time: 14:45 - 15:45
Room 4: D1-LP-06

1D – 1 (250) In search of a framework to facilitate statements of definitions in Physics: Is Feynman's Lectures on Physics a good guide?

Authors: WONG Chee Leong, YAP Kueh Chin, Singapore

The ability to define concepts and recognise correct relationships between concepts is necessary for explaining physical phenomena (Boxtel et al., 2000), and thus fosters meaningful learning. In connection with energy, for example, the teacher and pupil (Stylianidou & Ogborn, 1999) may feel confident when they have access to concrete definitions of the concepts. On the other hand, inaccuracies in definition (Galili, 2006) can suggest misconceptions or alternative conceptions. In fact, many fundamental concepts in Physics do not have *exact* definitions, and this may impede understanding of the nature of physics knowledge.

In addition, some insights from The Feynman Lectures on Physics, for example, suggest that there are at least four main problems of definitions, namely, circularity, context, precision and completeness. A framework can thus be developed to facilitate and improve the process of defining physical concepts for meaningful learning. Journal papers on several fundamental concepts in Physics are organized to validate this framework. Lastly, several problems of definitions in textbooks are analysed based on this framework. Implications to classroom teaching and assessment are also discussed.

1D – 2 (369) The effects of a facilitator on the performance of a heterogeneous working group in science and technology education

Author: LI Shing Sun, Hong Kong

Science education and technology education are two of the eight key learning areas as identified by the Education Bureau of the Hong Kong Special Administrative Region. The importance of scientific knowledge and technology in daily life is duly emphasized and is stated as the main objective of science and technology subjects in the reformed senior high curriculum. Also, the mode of learning is to change from the traditional approach which is teacher-centered to an interactive approach. 'Learning-by-doing' and 'co-operative learning' are considered as effective means to construct knowledge towards science and technology. However, there is no parallel emphasis in the curriculum of the primary education. It is found that a relatively lower ratio of secondary students would choose science and technology as their concentration in their senior-form study. Possibly, it might be due to the belief that science and technology are more difficult to learn than other subjects. In recent years, only a few schools in Hong Kong organize science and technology workshops for primary student, aiming at introducing science and technology in line with the rationale of the education reform. The School in which the researcher is serving is one of these schools. The present study is an 'experimental' study which investigates the effects of the facilitators, who are 'trained' junior secondary students of the School in 'generic skills', on the learning of science and technology of the 'heterogeneous' group formed by primary students, parents and the facilitators. The findings of this study reveal that the experimental groups, with the presence of the facilitators, obtain better achievements and attain higher levels of learning through 'co-operative learning' when compared with the control groups. It confirms the hypotheses that the facilitators can raise the effectiveness and efficiency of the working groups. In addition, their assistance enhances the working groups to 'value' science and technology. Hence, this study can shed light on the teaching and learning mode in the process of fundamental education and as well as on the 'train-the-trainers' programs and the 'mentoring' system commonly adopted in the business environment.

1D – 3 (320) An insight into bioethics education in high schools in Singapore

Author: HOH Yin Kiong, Singapore

Although science is viewed by some as objective, analytical and free of values, the practice of science does raise many ethical issues. Science teachers have an obligation to ensure that their students develop the skills to enable them to evaluate and make decisions about ethical issues associated with scientific advances so that they can make informed choices as adults. The purpose of this study was to examine the teaching of bioethics in the biology curriculum. Specifically, the study attempted to evaluate the effectiveness of a range of innovative teaching strategies used by teachers who were incorporating bioethics education into their high school biology curriculum. The study also attempted to determine the obstacles to students' successful engagement in learning bioethics.

Using a case study approach, the author examined the teaching practices of five biology teachers in five junior colleges. Each of these teachers taught Grade 11 biology courses that included a bioethics component.

All five teachers displayed potentially successful teaching strategies. They were committed to the inclusion of bioethics in their biology courses. They had clearly articulated pedagogical goals related to bioethics education. They endeavored to create secure learning environments in which students could clarify and explore their ethical values. When students expressed extreme views, the teachers, through careful questioning, challenged them to consider alternative ethical positions. It was noted that most of the learning activities were based on small group and whole class discussions. These activities provided opportunities for students to examine a topic in depth. Students were also provided with information to help them understand the scientific content before they could appreciate the associated ethical issues.

Obstacles that might inhibit student engagement in learning activities were identified, and these included students' moral maturity, academic ability, attitude to learning, beliefs about science and ethics, family and religious backgrounds.

The findings of the study were significant as they highlighted important issues that might need to be considered by curriculum planners and science teachers who wished to incorporate bioethics education into the biology curriculum.

Parallel Session 1E - Historical, Philosophical, Social, Cultural, and Gender Issues (與科學教育有關的歷史、哲學、社會、文化和性別事宜)
Date: 20 December 2010 (Monday)
Time: 14:45 - 15:45
Room 5: D1-LP-07

1E – 1 (140) 提升高中女生對化學課態度的實證研究

作者: 楊潔, 張善培, 香港

學生對科學課的態度非常重要，這點已在科學教育界達成共識，而如何提升學生，尤其是女生在對學校科學課的態度是近年來科學教育研究的熱點。

本研究通過如下兩條干預措施，對中國江蘇南京一個 41 人的高一班級進行課堂干預，嘗試提升女生對化學課的態度：1）學生分組實驗全部採用單性別分組；2）在課堂中採用 STS 教學，增加女生感興趣的與生活實際相關聯的內容。在干預前後分別利用筆者自編的四維度李克特量表對之進行測量，結果顯示，干預完成後，班級內全體學生對化學課態度各維度得分均有所上升，但女生進步較男生更大，男女生在前測中所顯示出的 3 個維度上的顯著性別差異全部消失；而課堂觀察和學生訪問的相關資料亦證實，這兩項干預措施對縮減該班男女生對化學課態度的性別差異確實有效。

1E – 2 (158) 以腦波研究法探討大學生 3D 化學結構式辨識之差異

作者: 黃琴扉, 劉寶元, 劉嘉茹, 台灣

本研究的主要目的是透過大腦-教育-發展模式 (BR-EDU-DEV model)，以腦波研究方法，探討大學生在三維 (Three Dimension, 3D) 化學結構式辨識上的差異。本研究以 29 位主修自然科領域的大學生（平均年齡 21 歲）為研究對象。所有研究對象在實驗前均需填寫化學概念問卷，並進行事件相 關電位 (Event-Related Potentials, ERPs) 的腦波實驗；其中，ERPs 的實驗包含「3D 圖形辨識作業」以及「3D 化學結構式辨識作業」。在數據分析中，本研究依據化學概念問卷得分，將研究對象分為 高分組與低分組。研究結果顯示，利用 t 檢定分析高、低分組在 3D 圖形辨識作業的反應時間 (Reaction Time, RT) 、答對率 (Correct Rate, CR) 與腦波振幅均未達顯著；其表示高、低分組在領域一般性 (Domain-General) 的圖形辨識上具有同質性。然而在 3D 化學結構式的辨識中，高分組的 RT 比低分組短、CR 得分較高；而腦波分析結果顯示高分組在大腦的額葉與頂葉產生 N270 成份波，其振幅比低分組大且達顯著 ($t = -8.3, P < .001$) 。ERPs 的文獻中指出，當大腦監控到外界刺激與先備經驗產生衝突時，便會產生 N270 成份波。總結來說，高分組在領域特定性 (Domain Specific) 的 3D 表徵辨識中，因具備較高的背景知識，所以反應較快、得分較高，且大腦呈現較佳的認知衝突監控能力。

1E – 3 (108) 國小五年級科學史融入天文教學之研究

作者: 賴慶三, 吳盈妮, 台灣

本研究之目的，在探討國小五年級實施科學史融入天文教學之成效。研究對象為臺北縣某國小五年級學生二班，分為實驗組與對照組，計有 68 名學生。教學單元為「太陽與星星」，實驗組採取科學史融入教學的方式實施教學，對照組則依教科書教學指引進行一般教學。研究工具包括「天文概念測驗」與「對科學的態度量表」。教學 活動實施前後，兩組學生經施以前、後測，進行單因數共變數分析。

研究結果發現：接受科學史融入教學之學生，其整體天文概念的學習成效，顯著優於對照組學生；接受科學史融入教學之學生，其對科學的態度的表現，顯著優於對照組學生；實驗組學生對科學史的學習感受，普遍呈現正向的看法，表達喜愛科學史融入教學，並能覺察到科學進步的歷程與演進，以及科學家所扮演的角色。研究結果顯示，科學史融入教學有助於國小五年級學生的天文學習，值得加強研究推廣。

Parallel Session 1F - Historical, Philosophical, Social, Cultural, and Gender Issues (與科學教育有關的歷史、哲學、社會、文化和性別事宜)

Date: 20 December 2010 (Monday)
Time: 14:45 - 15:45
Room 6: D1-LP-08

(88) 高中物理教科書評價指標體系的國際比較研究

作者: 鄧磊, 中國

本文首先對英國蘇薩克斯物理教材分析方法（University Sussex Education Area Occasional）、美國 2061 計畫高中物理教科書評價工具（科學促進會）、日本物理教科書評價體系（文部省）、菲律賓（教育部）高中物理教科書評價體系以及我國（中國）高中物理教科書評價指標體系進行了一個簡介，然後從：“內容分析”(content analysis) 和“教學分析”(instructional analysis)兩個層面進行了中外高中物理教科書評價指標的比較研究，發現在教科書的內容分析層面上各國都比較一致，都比較重視教科書的編寫品質、內容設置、目標設計等；但是在教學分析層面，我國在教科書的適應性、重視教學策略的選擇以及重視教學評價的要求等方面有所欠缺。在本研究指標比較的維度上，採用了評分者信度值進行檢驗，r 值為 0.85

於是，在此基礎上提出了建構我國高中物理教科書評價的指標體系構想。具體包括：教材內容（下設 6 個二級指標）、教學策略觀（下設 5 個二級指標）、教學評價（下設 2 個二級指標）、教材思想（下設 4 個二級指標）、實驗與探究（下設 5 個二級指標）、配套資源（下設 4 個二級指標）以及教材設計及品質（下設 3 個二級指標）為主的 7 個維度，共 25 個指標體系，並對該指標體系也進行了評分者信度的檢驗，r 值為 0.78。

1E – 2 (213) 兩篇「能量塔」文本之比較分析研究

作者: 葉佳承, 楊文金, 台灣

本文旨在分析比較兩篇能量塔文本的語言特性及其差異。選取台灣七年級 N、H 版本生態系單元能量塔概念有關的論述為標的文本，以逐步文本分析系統分析比較兩 篇文本的基本語言、漢語及科學語言等特性之差異。研究發現兩篇文本的詞彙密度、科學詞彙密度及關鍵字……等基本語言特性並無差異；從漢語特性的向度來看， 能提供讀者回溯零代詞與區辨含「的」的名詞組是否具分類意涵等語言訊息的版本，對讀者的閱讀理解較有幫助；構作科學概念時，能由具體事件逐漸抽象化，並使用多元的連接關係以供讀者理解構作歷程及事件間的邏輯關係，較符合讀者的認知與語言發展歷程。評審科學文本不應只考量科學詞彙等基本語言特性，漢語及科學語言特性應是評估文本良窳的重要指標。

1F – 3 (236) 技專生對專業化學課程與日常化學事物的學習態度之研究

作者: 丁信中, 台灣

本研究的目的在於探討台灣技專院校學生對於專業化學與日常化學的學習信心和學習興趣是否存在差異，以及這些學習態度受到哪些因素的影響，是否影響著他們對於科技相關職業的就業傾向。本研究計劃共分三年進行，此次報告為第二年研究的執行成果。研究對象為台灣中部與南部某兩所科技大學妝品、食品、環工等系的學生。第一年針對 60 位學生所進行的半結構性晤談的分析結果顯示：超過半數的受試者對於中學的理化不感興趣，原因在於：考試太多、成績不佳、課程抽象等。約半數學生對於大學的基礎化學課程不感興趣，原因在於：化學計算太多、概念過於抽象等，然而，他們對於生活化學事物是較感興趣的，高於學校科學學習經驗的感受。雖然專業化學的學習對多數學生有所困難，但是他們仍會選擇與其就讀科系相關的工作。第二年研究的執行重點在於進行量化問卷的發展與施測，包含：技專學生日常化學學習興趣問卷，技專學生化學學習動機問卷，技專學生化學學習經驗與學習壓力問卷等。這些問卷預計將於六月進行小樣本預試，九月進行正式施測。此次發表將探討技專學生對於專業化學課程的學習經驗、學習動機與日常化學學習興趣之間的關係，以及這些訊息對於專業化學課程規劃的建議。

Parallel Session 1G – Science Education in Taiwan (台灣的科學教育)

Date: 20 December 2010 (Monday)
Time: 14:45 – 15:45
Room 7: D2-LP-05

1G – 1 (155) An exploration of aboriginal secondary boys' and girls' learning interests and learning in science

Authors: HONG Zuway-R, YU Tien-Chi, CHIANG Wei-Hao, CHENG Mei-Shui, Taiwan

Aboriginal students have underrepresented learning outcome in science and Mathematics in Taiwan (e.g., Hong, Lin & Lawrenz, 2008). The purpose of this study was to investigate aboriginal boys' and girls' learning interests, favorite subjects, and find the most suitable teaching strategies for them. A total of 86 students (i.e., 34 7th graders and 52 of 8th graders) were randomly selected from a Southern Taiwan Aboriginal Tribal schools to complete the Secondary School Student Questionnaire (SSSQ) in 2010. Furthermore, four 7th and four 8th graders were randomly selected from the sampled students as target students for follow-up individual interviews. The interview results were used for triangulation and consolidation of the quantitative results. MANOVAs, t-tests, ANOVAs, and content analysis revealed significantly differences among the boys' and girls' favorite's subjects, most productive learning in science classes, learning-orientation, achievement-orientation, task value, and attitudes toward learning science. The initial findings are as follows:

1. Aboriginal secondary school boys reported that their top two favorite subjects are physical education and science; whereas girls revealed that their first and second favorite subjects are language and home economics.
2. Boys reported that their first and second outform subjects are physical education and language. Girls revealed that their first and second favorite subjects are language and arts.
3. Boys reported that their favorite teaching strategy in science classes are teacher-centered lecture and out-door science activity; on the other hand, girls revealed that their first and second favorite teaching strategy in science classes are out-door science activity, and student-centered learning.
4. The boys reported that their top two productive learning science activity are student-centered learning and small group discussion. Meanwhile, the girls revealed that their top two productive learning science activity are student-centered learning and small group discussion.
5. Aboriginal secondary school students with higher science grade yielded a significantly higher achievement-orientation scores of $F(4, 82) = 2.48$, $p<.05$* than those students with moderate (Mean Difference = 11.22, $p<.05$*) or lower science grade (Mean Difference = 10.09, $p<.05$*). In addition, students with moderate science grade yielded a significantly higher learning attitude scores ($F(2, 84) = 2.74$, $p<.05$*) than students with the higher science grade (Mean Difference = 7.17, $p<.05$*).
6. Aboriginal students with a stronger ambition to acquire a higher educational degrees (Ph. D.) yielded significantly higher achievement-orientation scores ($F(5, 81)= 2.82$, $p<.05$*) than students with moderate (Mean Difference = 5.24, $p<.05$*) or lower ambitions (Mean Difference =6.57, $p<.05$*).

Based on the result, it is highly recommendable for science teachers to focus on providing small group discussion, student-centered learning activities, and outdoor science activity for students. This is both attractive and scaffolding for students' interests in science learning and results in positive learning attitudes. Results indicates that providing girls with more opportunities to interact and discuss with peers may increase their interest in learning science. Implications for practices on aboriginal students will be presented.

1G – 2 (195) 國小男女學生在「能源與運輸工具」之實務研究

作者: 林容妃, 賴慶三, 台灣

社會化的過程讓男女學生從小被灌輸不同的價值觀，性別學習的刻版印象、差異成為教育數十年來沉重的包袱。科學課室裡的學習表徵，性別應只是代表男女生理構造上的不同，九年一貫課程綱要也將「性別平等教育」視為重大議題融入教學活動，所以課程與教學應朝向性別中立，注重性別教育機會均等。性別與科學研究一直是日益受到關注的議題，不僅我國政府各部會大力推動性別主流化政策，學界之研究也積極針對所有造成性別不平等的現象進行質疑與批判，並進一步嘗試尋求改進與解決之道。

本研究之目的，透過實施「能源與運輸工具」的教學活動，探討：(1)男女學生對「能源與運輸工具」的學習差異；(2)科學教師對男女學生學習的想法與信念。本研究利用文獻分析、教學現場觀察、晤談等方法，進行資料搜集與分析，以探討國小男女學生在能源與運輸工具單元學習之差異。研究結果發現，男女學生對能源與運輸工具單元的科學學習歷程存有若干差異，本研究並對其提出討論與建議。

1G – 3 (177) 朝向小學教師科學教學知識增能的專業合作探究取向

作者: 熊召弟, 熊同鑫, 林胤彤, 台灣

本研究主要的目的是透過為期六週（每週 6 小時）的「小學教師自然與生活科技領與教材教法增能班」的實務行動促進小學專家科學教師對於科學教學知識(science pedagogical content knowledge)的理解以及應用。大學教授(4 位科學教授、2 位科教學者)與小學專家教師(8 位)攜手形成合作專業發展模式(model of cooperative professional development)，發展提昇一般在職科學教師培訓的教學模組以及工作坊。研究歷程以現場教學實錄、訪談、檔資料等的轉譯以及針對科學教學知識能力的向度進行資料分析以及歸納研究成果。本文擬以「岩石、土壤、地層」以及「天氣」兩單元課程案例，呈現大學教授與小學科學專家教師的個別特長以及合作互補匯集提供一般教師的科學專業教學素材。研究結果顯示:（1）大學教授提供豐富的、當代的的科學內容，專家教師轉化成活潑的、小學教學可行的活動材料；（2）合作專業發展模式中大學教授與小學專家 教師的社群互動文化，提升雙方對小學科學教學本質的理解；(3)結合大學與國小專家教師的合作模式，可提供在職教師實際可用的學科知識和教學實務的技能。最後藉由研究者省思，提出結合師資培育機構與國小自然專家科學教師合作可行的專業進修模式之建議。

Parallel Session 2A - ICT in Science Education(科學教育與科技)

Date: 20 December 2010 (Monday)
Time: 16:00 - 17:00
Room 1: D2-LP-08

2A – 1 (291)「科學知識」與「科學資訊來源」對大學生擬科學態度影響之研究

作者: 謝佩妤, 蘇懿生, 黃台珠, 台灣

本研究旨在探討大學生的科學知識程度與科學資訊來源接觸頻率不同，是否會影響其「擬科學態度」而造成差異，並探究其相信或從事擬科學活動與否的理由，以瞭解大學生無法區辨擬科學原因。研究方法為採用調查研究法，以台灣 450 名大學生為研究對象進行施測，分析方法為 ANOVA 量化統計與質性分析。結果顯示：(一)不同科學知識程度的大學生在擬科學態度無顯著差異，科學知識測驗成績好的大學生，並沒有比成績差的大學生更會懷疑擬科學的主張;(二)不同科學資訊 接觸頻率的大學生在擬科學態度有顯著差異，顯示大學生若接觸科學資訊來源頻率較高則較為相信及從事擬科學；其中科學科技雜誌閱讀頻率越高的大學生較為相信 超自然擬科學以及從事運勢擬科學與健康擬科學;大學生科學節目收視頻率越高則較為從事健康擬科學，科學場所參觀頻率越高的大學生較為相信超自然擬科學; (三)大學生相信擬科學與否之理由，以擬科學是否存在矛盾實例、是否沒有實驗證據、是否斷言不合邏輯、是否在多種可能解釋的情況下僅取其一，以及是否缺乏有力證據或理論之幾點來作為爭論點;在從事擬科學與否理由部份，大學生以本身的認知考量包含相信與否，以及所接觸的環境社會包含資訊來源的接受來構築從事 擬科學與否的標線。

2A – 2 (259) 應用個人回饋系統在資訊安全素養課程之運用

作者: 林凱胤, 林宇健, 台灣

回饋和評量在教與學的過程中扮演著非常重要的角色，Bransford, Brown and Cocking(2000)就強調，一個有效的教學應能在教學過程中不斷地給予學生回饋，並且時時監控學生的表現，藉以瞭解學生的學習情形。個人回饋系統 (PRS)是一套可以讓學生在課堂中即時回饋資訊給老師的一種教學應用系統，教師以 PowerPoint 在螢幕上提問，學生各持一個遙控器回答問題，系統可同時蒐集所有學生的答案，並以視覺化圖表呈現作答結果，藉此促進課堂互動、提升學習動機和學習成效。本研究導入 PRS，以修習計算機概論的學生為研究對象，資訊安全為教學內容，採準實驗研究法，進行為期二週八節課的實驗教學，二組均以 PowerPoint 講述，實驗組(N=51)採 PRS 即時評量及回饋，控制組(N=51)則以課後評量，實驗結束後，實施資訊安全素養測驗、學習動機問卷、態度量表等，初步結果：1.資訊安全素養成績，實驗組明顯高於控制組，但未呈現顯著差異；2.在學習動機各向度實驗組也優於控制組，特別是在自我效能與主動學習面向；3.大多數實驗組學生對 PRS 持正向且積極的看法，但有少數學生表示有壓力及焦慮感。

2A – 3 (307) 概念圖認知工具在小學科學中的應用

作者: 鄭雪萍, 中國

學生獲取外界資訊主要通過視覺和聽覺，視覺資訊占了 83%，聽覺占了 11%。從這個角度來說，概念圖是運用圖像和網路聯想的一種認知工具，能夠促進學生學習的意義建構和對知識的記憶。概念圖能夠使學生進行合作學習和創造性學習，最終使學生學會學習。對學生來說，概念圖能促使他們整合新舊知識，濃縮建構知識網路，知識結構，從而使學生從整體上把握知識。

本研究主要採用案例研究法和行動研究法，在小學科學中高年段開展研究。通過迴圈跟進和主題交流、課例觀摩等方式進行研究，並提供天河部落作為研究交流和資源分享平臺；收集師生的概念圖作品和教學案例；分析案例從中瞭解概念圖作為認知工具對於學生進行知識有意義建構的作用。

通過研究得出初步的啟示和結論。一是作為小學生通過學習，能很快掌握概念圖軟體，（如 Inspiration 概念圖軟體），並利用概念圖軟體進行概念建構；二是通過學生的概念圖作品可以反映出學生思維過程和掌握概念的情況；三是通過概念圖認知工具能夠促進學生之間的相互交流和學習，不斷反思和完善各自的知識結構；四是教師在檢查學生的概念圖作品中，可以發現學生對概念的理解程度，從而可以學生的認知情況改進教學。

本研究對小學科學教學的建議：一對教師的建議。隨著教育技術的發展，教師要敢於嘗試，敢於運用新的技術去教學，改變教學的方式。恰當地運用這些技術去有效促進學生的學習；二對學生學習的建議。學生的學習能力是非常強大的，他們接受新的事物也是非常強的，把概念圖作為學習的工具，能有效促進學生知識的建構；三對教材的建議。教材可以採用一些概念圖的形式，豐富教材的內容，增加對學生的思維有有說明的概念圖內容，並能夠吸引學生的去學習。

本研究存在的問題和下一步工作。在研究中發現概念圖教學的評估及評估量表制定問題是一個難點。另外概念圖在小學科學教學中的應用的信度和效度問題，需要進一步的研究和整理分析。下一步工作主要是進行准實驗研究和比較分析研究，從而提高本研究的信度和效度。

Parallel Session 2B - Learning and Teaching Science (科學教學策略)

Date: 20 December 2010 (Monday)
Time: 16:00 - 17:00
Room 2: D2-LP-09

2B – 1 (151) Teaching school science within the cognitive and affective domains

Authors: TAN Kok Siang, HENG Chong Yong, LIN Zi Kai, TAN Shu Hui, Singapore

The school science curriculum often covers the cognitive, affective and psychomotor learning domains. In class, science is usually taught within the cognitive domain while the psychomotor learning domain is achieved through performing science experiments in the laboratory. Although students attend civic and moral education (CME) and pastoral care classes where values and soft skills are often taught directly to them, learning experiences in most school subjects such as science are still centred on preparing for high stakes examinations. It is therefore not surprising that affective domain learning outcomes are often the least considered when teachers plan or conduct their science lessons. With globalization and advancements in information technology, skills within the affective domain are becoming more relevant as these become the "must-have" for the 21st century worker-citizen. Thus, the question that educators and teachers will need to ask is "How can we teach and prepare the younger generation to be that effective 21st century worker-citizen with an inquiring mind and a compassionate heart?"

In this school-based initiative, secondary school students are taught science concepts in the usual approaches that would effectively prepare them to achieve the curricular cognitive and psychomotor learning outcomes. In addition, reflective activities on some daily life experiences are incorporated into their science lessons. The aim of the science lesson is therefore two-fold: (1) to teach the science concept so that students understand it well enough to use it in solving conceptual problems in examinations, and, (2) to develop in students an awareness of a positive social habit or soft skill that they can relate with by drawing analogous similarities from the concept learnt.

In school A, 32 Secondary 4 Normal Technical students were taught the topic on chemical reaction using the characteristic reactivity of potassium metal. The reactive nature of potassium was then used as a lead in for students to reflect on their own social behavior when they were involved in a heated argument or misunderstanding. In school B, 11 Secondary 2 Express students were taught the concept of strength of acids. In that lesson, students were asked to conduct a simple experiment to compare the reactivity of two acids of different strengths. Then they were asked to relate their spending habits to their experimental observations. It was found that their reflections had made them realize the need to be frugal in managing their daily allowances.

Responses and feedback from both students and teachers were collected and analyzed for learning patterns. The students' social habits and behavioral characteristics are evident through their responses to the reflective activities. The participating teachers also contributed their knowledge of their students' learning preferences and personalities. The findings, though qualitative in nature, provide exciting insights into how engaged learning in science can create a heightened awareness among students on their own social habits and behavioral characteristics. Thus, by teaching students science within both the cognitive and affective domains, an opportunity may be created for educators and teachers to lead students into the affective domain through the cognitive door.

2B – 2 (243)The use of small-group discussion, guiding questions and molecular models to teach molecular geometry and polarity

Author: TEH Yun Ling, Singapore

This mixed-methods research study aims to investigate the effectiveness and efficiency of various instructional treatments, including small-group discussion, use of guiding questions and molecular models, within a 1-hour tutorial session, in the topics of Molecular Geometry and Polarity. The study was conducted in the two top universities in Singapore. This study hopes to draw the attention of curriculum planners and teachers on the pros and cons of some instructional methods, so as to improve the quality of teaching and learning of Chemistry.

To achieve greater depth to the research findings, data were collected using both quantitative and qualitative methods. The quantitative data the impact of various instructional treatments were determined by statistical analyses on the concept test scores and confidence ratings. Information on students' views on the instructional methods were revealed from the semi-structured interviews, which served as the qualitative data.

Although no significant difference was found among the individual instructional treatments statistically based on the scores of pre- and post-tests, results obtained from the confidence tier showed that students were generally more confident when their answers were correct, less confidence when their answers were wrong, had higher confidence discrimination and showed closer to perfect calibration after the instructional treatments. These data suggests that the one-hour instructional treatment session had produced some impact in improving students' understanding in the chosen Chemistry topics. Note that convenience sampling was used in this research study and the students were non-systematically distributed into the various treatment groups due to logistic constraint.

These instructional treatments were well-received by the interviewees although some of them found small-group discussion was not effective. Many studies reported that concrete molecular models helped the students to visualize the molecular geometries and improved their conceptual understanding (e.g. Ferk & Vrtacnik, 2003). However, this study found out that a minority of the students resent building such models while some were confused by the representations of the models (i.e. the sticks and the balls). Guiding questions used in a class have several merits (Francisco et al., 1998) but found to be not practical in a one-hour tutorial setting in this study because it was time consuming and the range of students' conceptual understanding levels was wide.

2B – 3 (116) The investigation of Taiwanese elementary school students' self-efficacy and learning in science

Authors: HONG Zuway-R, LIN Huann-Shyang, CHEN Hsiang-Ting, WANG Hsin-Hui, YANG Kuay-Keng, Taiwan

The purpose of this cross sectional study was to investigate the relationships between students' self-efficacy and their learning in science in Southern Taiwan. A total of 149 students (i.e., 98 of 4th graders and 51 of 6th graders) completed the Elementary School Student Questionnaire (ESSQ) in 2009. Furthermore, 12 target students were randomly selected from the sampled students for triangulation and consolidation of the quantitative results. MANOVAs, t-tests, Spearman correlation, ANOVAs, and multiple approach method revealed significant relations among the participants' self-efficacy with science learning and personal potential characteristics. The results are as follows:

1. The six most important learning factors in science classroom that correlated with students' self-efficacy were: inquiry ability (r = .65***), science teacher support (r = .55***), high involvement (r = .52***), effects from science learning (r = 49***), classroom cohesive (r = 48***), and task-orientation (r = .48***).
2. Elementary school students with higher GPA (grade point average) presented significantly higher inquiry ability scores (F (2, 147)= 4.975, p<05*) than those students with moderate or lower GPA.
3. Elementary school students with higher GPA yielded a significantly higher self-efficacy scores of F (2, 147) = 5.86, p<000*** than those students with moderate or lower GPA.
4. Elementary school students with higher science grade presented significantly higher self-efficacy scores (F (2, 147) = 5.59, p<000***) than those students with moderate or lower GPA.
5. Elementary school students with a stronger ambition to acquire on higher educational degrees has yielded a significantly higher self-efficacy total scores of (F(2, 147)= 2.59, p<05*) than those students with lower ambitions.
6. Children under higher expectation to obtain higher educational degrees from their father has found to scored a higher self-efficacy total scores of (F(2, 147)= 2.59, p<05*) than those children receiving lower expectation from their father.)
7. Mothers with higher expectation on her children towards obtaining higher educational degree levels has resulted in children's higher self-efficacy total scores (F(2, 147)= 3.66, p<05*) than those with lower expectations from their father.
8. 4th graders' self-efficacy total scores were significantly higher than 6th graders' scores (t = 3.26, p<01**).

Based on the result, it is highly recommendable for the science teachers to create an open and friendly learning environment that is both supportive and fair to each pupil and as well as to encouraging students to participate in the classroom activities. This will not only increase student's interaction but also promote their self-efficacy that has positive impacts on learning science. Implications for practices and research will be presented.

Parallel Session 2C - Science Education in Life-wide/Authentic/Informal Contexts (課外或全方位的科學教育)

Date: 20 December 2010 (Monday)
Time: 16:00 - 17:00
Room 3: D2-LP-10

2C – 1(107)國小五年級生物多樣性教學之研究

作者: 賴慶三, 許凱琳, 台灣

本研究之目的，在探究國小五年級實施生物多樣性教學活動之成效。研究對象為臺北縣某國小五年級的4個班級，共140位學生，分成實驗組2班，對照組2班，實驗組實施六週的「生物多樣性世界」生物多樣性教學活動，對照組則進行「形形色色的生物」一般教學活動。研究工具，包括：「生物多樣性學習成就測驗」與「環境態度及行為量表」，於教學活動實施前後，分別進行前、後測的施測，並以單因數共變數分析，進行學習成效之分析比較。

研究結果發現，在實施生物多樣性教學活動後，實驗組學生獲得的生物多樣性概念，顯著優於對照組的學生；其次，在環境態度與行為的表現上，實驗組學生的表現，亦顯著比對照組學生具有更正向的環境態度與行為表現。研究結果顯示，國小五年級生物多樣性教學活動，可以有效增進學生的學習興趣與成效，所以生物多樣性議題值得融入自然與生活科技領域加強研究推廣。

2C – 3 (278) 探索學生對非制式奈米科學課程的學習興趣

作者: 鄭瑞洲, 黃台珠, 卓宴榆, 羅茂彰, 程重鳴, 台灣

本研究主要探討在增進學生科學課程理解及成就的教學中，如何提升學生對科學課程的學習興趣，研究對象為國小五、六年級（N=94）、國中（N=93）及高中（N=130）三組學生共計317位學生，由國小、國中及高中三階段自然科教師團隊，針對三組學生分別進行以動手作為主的奈米科學課程，以瞭解在教學前後學生對奈米科學課程的興趣、對課程理解的自信心及概念成就評量上改變之情形，此外以錄影及分析課程進行中的師生互動模式及教師的教學策略，探討其是否影響學生之學習興趣。

研究結果發現，學生認為最能引起學習興趣的科學課程進行方式，約有85~90%學生選擇以動手做及能操作實驗為主的課程，此外在課程內容上約有32~73%學生選擇教學內容需與日常生活有關、有趣的、沒經驗過及沒學習過的。

另外，學生經過以動手作為主的非制式奈米科學課程，教學前後三組學生對奈米科學的課程理解及概念學習成就，兩者皆有顯著成長，進一步瞭解教學前後各組學生對科學課程的學習興趣，亦呈現顯著性之增加，以國小學生增加最多、其次為國中生、再次為高中學生。

另外以教學中教師採用的教學策略及師生互動模式分別分析三組教師之教學過程，國小組教師採用教學策略為最多元，且師生互動時間為最多；國中組教師採用教學策略及師生互動時間均次之；高中組教師以投影片講述為主的教學策略，師生互動時間最少。

本研究發現，以動手做及操作實驗為主的非制式奈米科學課程，確實能引發學生對科學課程的學習興趣及理解，進一步發現教師於教學中採用的多元教學策略及師生互動模式可能與科學課程學習興趣的增加有所關連，此部分值得進一步的探討。

2C – 3 (296) 社會公民氣象媒體素養

作者: 古智雄, 蔡易輯, 台灣

本研究從社會脈絡、學校教育及氣象傳播中的氣象素養議題為 主軸，目的在探討小學生、中學生、及社會公民三類對象的「氣象傳播相關之媒體素養基本能力」(簡稱「氣象媒體素養基本能力」)。研究採大慧調查法 (Delphi Technique)，邀請自然與生活科技領域教師、科學教育、傳播、大氣科學等四個領域專家，共16 位，針對氣象媒體素養基本能力進行專家審查以獲得共 識。研究工具為「氣象媒體素養基本能力問卷」，內容主要立基於中華民國教育部(2002)的《媒體素養教育政策白皮書》，問卷的構念組成及命題是從科學教 育的觀點，結合社會脈絡、學校教育及氣象傳播等三個面向中的氣象概念教/學現況發展而成。經過二輪的專家審查後，審查結果指出現代社會公民應具備的氣象相關媒體素養，應包括(1)瞭解媒體氣象訊息內容、(2)思辨媒體氣象內容的表徵、(3)反思媒體氣象資訊閱聽人的意義、(4)分析媒體氣象報導組織、及 (5)影響和近用媒體氣象資訊等五大向度，內容涵蓋 22 個基本能力。研究結果界定出現代社會公民，必須具備的「氣象媒體素養」基本能力，同時也指出中小學階段(1-12)學生應具備的氣象媒體素養，對於未來科學教育在氣象素養議題的教學、傳播及實踐等取向上，提供了更明確的方向。

Parallel Session 2D – Assessment of Students' Science Learning and Development (學生科學學習與發展的評估)

Date: 20 December 2010 (Monday)
Time: 16:00 - 17:00
Room 4: D1-LP-06

2D – 2 (228) 科學論述中文言到白話過度之研究—以牛頓第一運動定律為例

作者: 范賢娟, 楊文金, 台灣

本研究旨在探討漢語翻譯是如何從傳統文化與語言中汲取資源 向華人世界介紹西方科學，研究以 1960 年以前的中學物理教科書中的牛頓第一運動定律的敘述為例，國(初)中 29 版本，高中 7 版本，共 36 版本。研究設計 以文言文與白話文所使用的連接詞、語助詞來判斷各版本所使用的文體，其次根據各時期文言版本與白話版本出現的數量來劃分時期，並比較各時期的用詞特徵。結 果將此階段分為三個時期：一是文言表達時期(1905-1929)，此時期每個版本的用字與語法均具有文言文之特徵，標點符號由簡單而複雜，許多詞彙由古 文轉借或組合而來，許多專有名詞還未統一，語法可見對仗之遺風；第二是文言白話紛陳時期(1930-1947)，此時文言的詞彙與語法比例漸少，白話文比例漸多，標點符號的系統日漸成形穩定，專有名詞仍未統一，對仗之風仍在，甚至更甚於前期；第三為白話表達時期(1948-1960)，此時文言語法已不再 出現，標點符號系統已普遍使用，專有名詞已漸統一，對仗之風消除。藉由本研究看可以到上世紀的 50 多年裡，科學教科書從傳統詞彙、語法與格式中，汲取元素 來介紹西方的概念，這些有的是有助表達的工具，有的則是障礙。

2D – 2 (172) 國小高年級學童颱風現象概念問卷之研究

作者: 黃皇明, 全中平, 台灣

本研究旨在研發「國小高年級學童颱風現象及其相關概念」之筆試問卷工具，探討大臺北地區學童對颱風現象及其相關概念的認知現況。研究對像是大臺北地區國小五年級學童，有效樣本數為 885 名，預試問卷測驗之內部一致性係數為 a＝.6412，重測信度為.754， 效標關聯效度 Pearson 相關係數.336。

本研究發現之研究結果有下列數項：一、大臺北地區五年級學童對於有關「氣壓特性」方面的概念最欠缺(52.3%)；其次為有關「颱風特性」方面的概念(58.8%)；再其次為「颱風形成原因」方面的概念(61.3%)，而大部份學童對於有關「颱風天氣型態」方面的概念較為完整(68.5%)。二、學童的颱風動態消息最主要為「傳播媒體」(33.0%)，其次為「親朋好友」(21.6%)，再其次是「電腦網路」(19.9%)。

建議：一、本研究所使用的自編「國小學童颱風現象概念問卷」中，如能再加上適當數量學童的訪談歸類資料，則能使問題的答項更為適切。二、本研究的問卷建議盡量採用動態呈現的效果，尤其是颱風動態的題目，應可有效提高學童施測的意願及準確性。

2D – 3 (371) 澳門中學科學教學: 問題與挑戰

作者: 魏冰, 澳門

我們知道，科學課程與教學問題是學校科學教育的一個核心問題，與一定社會的文化傳統和教育制度密切相關，學生的學習是其中的一個重要方面。因此,學生的"學習結果既會受到（教育）內部因素影響也會受到（教育）外部因素的影響"(Guo, 2007)。這一論斷從在 PISA 2006 科學成績排名第一的芬蘭的成功經驗中得到證實。根據有關學者的研究，芬蘭學生的良好的科學素養表現既可以從該國的宏觀政策（例如，以知識為本的社會、教育公平、高度的地方自主）得到解釋，也與其教師教育（教師的學歷要求較高，教師專業化程度較高，教師的專業知識面廣等）、學校課程（科學課程的教學時數較多）和學生的學習態度和對科學的興趣（用科學和學科學的自信心較強）等因素密切相關(Lavonen & Laaksonen, 2009)。本文主要依據澳門特別行政區教育暨青年局委託澳門大學教育學院完成的《澳門中小學自然科學教育評鑒報告》中的有關資料，重點從學校科學課程與教學層面為澳門中學生的科學素養總體表現提供背景性的解釋，希望為改善澳門中學科學教學品質，進一步提高學生的科學素養表現有所裨益。

Symposium 1 - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)

Date: 20 December 2010 (Monday)
Time: 16:00 - 17:00
Room 5: D1-LP-07

Symposium 1 : (332) Preparing teachers for teaching nature of science: A video-based approach

Authors: YUNG Hin Wai, WONG Siu Ling, YIP Wing Yan, LAI Ching, LO Man Sum, LIE Ho Yin, Hong Kong

In line with the international trend, recent development of science curricula in Hong Kong has seen a shift from the predominantly content-focused goal to a wider goal of promotion of scientific literacy in which understanding of nature of science (NOS) occupies a pivotal role. This poses a host of challenges in preparing teachers for teaching these new curricula. In particular, various studies consistently point to teachers' inadequate understanding of NOS and their lack of pedagogical skills in teaching NOS.

In this symposium, we report our experiences in preparing teachers for teaching NOS, in particular, those involving video as a mediating artifact. In the first presentation, we report a teacher's story of his journey of professional development from learning of NOS to effective teaching of NOS. With an in-depth reflection of his journey with a science teacher educator, they have come to identify several critical events and processes which have prompted considerable advancement in his pedagogical skills in teaching NOS. His classroom video episodes have been used as exemplars to develop and motivate other teachers in building their repertoire of teaching NOS.

The second and third presentations are based on our experiences in working collaboratively with teachers in study group meetings where they learned how to teach NOS through critical reflection on videos of their own teaching. In the second presentation, we provide empirical evidence to support our claim that in order to bring out the desired learning, the videos should be compiled and organized around themes that are meaningful to the teachers. In the third presentation, we explore the nature of discussions that were taking place in the study group meetings. Our aim is to delineate features of the study group meetings that can help generate productive discussions in a video-mediated learning environment. Special attention will be paid to teachers' affective and social learning in the course of their participation in discussion.

In the fourth presentation, we shift our focus to helping preservice teachers to teach NOS. To supplement the lack of opportunities to observe NOS instruction in action, our student teachers were provided with two videos of exemplary NOS teaching: one using an implicit approach and an explicit reflective approach in another. They were asked to review and comment on the videos at three stages of the program (at the beginning of the program, before the main teaching practicum, and just before the program ended). In this presentation, we report the effectiveness of this progressive video commenting task in developing effective NOS pedagogy among the pre-service teachers.

We conclude the symposium by presenting a model of effective use of video for teacher professional development based on findings from the above presentations.

Symposium 2 - Development of Science Curriculum (科學課程發展)

Date: 20 December 2010 (Monday)
Time: 16:00 - 17:00
Room 6: D1-LP-08

Symposium 2 : (340) Curriculum reform and restructuring of senior secondary education in Hong Kong: Perceived challenges and implications

Authors: CHENG Nga Yee, LAM Chi Chung, YEUNG Yau Yuen, LEE Yeung Chun, LAM Chung Man, Hong Kong

The restructuring of the academic structure and curriculum of the senior secondary education in 2009 has witnessed the on-going drive of the Hong Kong Education Reform in 2000 for a "more flexible and diversified" curriculum (Education and Manpower Bureau, 2005, p.9). To develop students' ability to make connections across knowledge and concepts from different disciplines and to examine issues from multiple perspectives, new interdisciplinary subjects like Liberal Studies and Integrated Science are introduced into the new senior secondary curriculum. Whilst their introduction would definitely create stress and concerns of teachers, in preparing for new but broader subject content that may require completely different teaching strategies, teachers of traditional disciplinary subjects would also face new challenges through changes in the subject curriculum, teaching and assessment. This symposium therefore aims to discuss how teachers perceive the challenges of teaching interdisciplinary subjects and discipline-based subjects. Before the actual implementation of those new curricula, we have developed and administered specific research tools (in form of interview guidelines and questionnaires) to collect qualitative and quantitative data from curriculum planners and school teachers for the aforementioned interdisciplinary subjects and a number of disciplinary subjects, including Biology, Physics, Chemistry and Geography. Interview data will be used to discuss on how teacher-practitioners' views are compared with the curriculum planners towards the implementation of Liberal Studies and Integrated Science, whereas both interview and questionnaire survey data from teachers of disciplinary subjects of Biology, Physics, Chemistry and Geography have been analysed to reveal the teachers' key concerns and perceived problems as arisen from the change in curriculum organization and structure, emphasis on nature of science, science, technology, society and environment, fieldwork and inquiry approach of learning as well as school-based and field enquiry assessment. It is anticipated that through such sharing, a better and more informed understanding of the concerns of teachers would be collected to highlight implications for curriculum review and development as well as teacher education. The symposium comprises 6 presentations, listed as follows:

Interdisciplinary curricula

1. Integrated learning and Liberal Studies
2. Integrated learning and Integrated Science

Disciplinary curricula

3. Curriculum organization – a case of Biology
4. Nature of science and Science, Technology, Society and Environment – a case of Physics
5. Inquiry and school-based assessment – a case of Chemistry
6. School-based assessment and fieldwork enquiry – a case of Geography

Parallel Session 3A - ICT in Science Education(科學教育與科技)

Date: 20 December 2010 (Monday)
Time: 17:00 - 18:00
Room 1: D2-LP-08

3A – 1 (327) Online resource-based learning environment: Case studies in primary classrooms

Authors: SO Wing Mui, CHING Ngai Ying,
Hong Kong

Aim: This paper discusses the creation of learning environments with online resources by primary school teachers for pupil's learning of science-related topics with reference to the resource-based e-learning environments (RBeLEs) framework. The reasons for the teachers to choose particular contexts, resources, tools, and scaffolds in designing the learning environments are considered. Evaluation by the teachers and opinions from the pupils regarding the teaching and learning in the learning environments are also included.

Methodology: The teaching designs of three upper primary science-related topics were analysed using the four components of RBeLEs framework: creation of contexts, selection of resources, design of tools, and adoption of scaffolds. The three teaching designs were "Climate in China", "Connection and movements of bones", and "Hong Kong climate". The underpinning rationale and the post-lesson reflection on the designs by the teachers were captured through interviews with the three teachers who developed the teaching designs. Pupils' feelings about learning in the RBeLEs were revealed from interviews after the lessons.

Results: From the analysis of the teaching designs, it was discovered that the contexts were mostly determined by the teachers according to the curriculum and textbooks; only one teacher also incorporated some current issues. For online resources, two teachers made use of both dynamic and static resources from different sources, and one teacher only selected static resources. To foster pupils' learning, the teachers adopted tools for various tasks, including tools for processing information, searching and seeking, collecting information and data, organising, collaborating and integrating, and communicating. Different types of scaffolds were also designed to support pupils in asking and discussion, searching and selecting, doing and observing, and summarising and conceptualising while learning in the RBeLEs.

As revealed from interviews before the lessons, the teachers had given careful consideration to selecting online resources. Not only did the teachers give deeper thought to how the online resources could be used to promote pupils' learning, but they also matched them with appropriate tools for information/data manipulation and took into account the scaffolds needed. Nonetheless, the teachers mentioned after the lessons that they had over-estimated pupils' ability to handle the online resources and make meaning out of the information/data collected.

After the lessons, the pupils indicated that they were generally in favour of learning with the online resources, saying that the lessons were made more interesting. However, challenges in interacting with the online resources and using the tools were also mentioned, such as failing to locate the information needed and to provide answers to the questions.

Conclusion: Differences shown in the teachers' attempts to design learning environments with online resources for the three science-related topics suggest that the RBeLEs framework could be flexibly implemented and that further study on its applicability is recommended. Challenges encountered by pupils when learning in the RBeLEs also warrants attention to the extent of scaffolding needed as well as the level of resources and tools selected.

3A - 2 (297) Applying blogs for pre-service teachers in science education: From one's epistemology towards a pragmatic approach in collaborative and ubiquitous learning

Authors: CHUI Hin Leung, TSANG Po Keung,
Hong Kong

The purpose of this study is to explore the existing practice of a group of pre-service teachers majoring science education structured their learning. It also looks at the impacts of the introduction of Weblog (or blog) for one's knowledge construction. Particularly, the teachers' learning attitude, the methods of inquiry and perception of applying Web 2.0 tools in science education have also been evaluated. A questionnaire was given to the teachers

at the beginning of the research which was aimed at investigating their approaches in knowledge building in the context of science education and how they were making sense with those concepts in terms of teacher education. Basic training of blog features has been also given and practised before the teachers creating and using one's own blog for knowledge building. Throughout the period of our study, technical support and literatures related to blog practice in science education have been provided and discussed regularly with the participants. The concepts of personal learning environment (PLE) have been introduced to the participants. Participants' development on their PLE, the perception changes and the approaches on transferring one's own PLE into their teaching repositories were also reported. At the end of the research, all participants have been invited in the focus group interviews for an overall discussion on the impacts of one's epistemology, feasibility and level of application in collaborative learning by connecting one's own blog to the other science teachers' blogs. In the final stage, ubiquitous computing (or ubicomp) has been discussed for the participants with the pragmatic information and communication technologies (ICT) in order to sustain the inquiry nature and learning in science education.

3A – 3 (322) High school students' conceptual understandings and modeling practices in a computer-based modeling environment

Authors: WU Hsin-Kai, HSU Ying-Shao, HWANG Fu-Kwun, Taiwan

The purpose of this study is to investigate the development of high school students' conceptual understandings and modeling practices in a computer-based modeling Environment, Air Pollution Modeling Environment (APoME). APoME, including a modeling tool and 5 learning lessons, was designed to help students develop a systematic view of air quality and understand complex interactions among air pollutants, topographic effects, and meteorological variables. The modeling tool allows students to establish relationships among variables, to manipulate dynamic simulations to test relationships, to visualize how the pollutant concentration changes over time, and to apply their models to different cases. The five lessons introduce scientific concepts about air quality (e.g., atmospheric stability and wind speed), support students' exploration of variables, and engage students in building a model about air pollutant dispersion.

One teacher and 23 tenth graders participated in the study and multiple sources of data (e.g., pre- and post-tests, interviews, and recordings of computer activities) were collected to examine students' learning performances in APoME. The results show that students' understandings about air quality were significantly improved after they engaged in the APoME activities ($t = 6.942$, $p < .01$, effect size = 1.78). The item analysis indicates that while students did not improve on the items involving factual knowledge (e.g., sources of air pollution and types of pollutants), they performed significantly better on items that required them to explain the formation mechanism of air pollutants, predict atmospheric stability under different weather conditions, and describe how vertical temperature structure affects air pollutant dispersion. Additionally, students' modeling practices evolved throughout the lessons. After engaging in the lessons, students identified more major variables relevant to air pollutant dispersion, provided more accurate descriptions about the relationships between variables, and carefully controlled and manipulated variables to test their model. These findings suggest that APoME is effective in supporting students to develop substantial understandings about air quality and demonstrate desirable modeling practices.

However, analyses of the qualitative data also showed that students experienced difficulty in visualizing shapes of stack gas plumes by using 2-dimentional representations and held inaccurate understandings about how to use the temperature lapse rates to determine atmospheric stability. These findings will help us revise the modeling tool and the lessons.

Parallel Session 3B - Learning and Teaching Science (科學教學策略)

Date: 20 December 2010 (Monday)
Time: 17:00 - 18:00
Room 2: D2-LP-09

3B – 1 (153) 創造性問題解決融入科學遊戲的教學行動研究-以「光」為例

作者: 許良榮, 蕭淑分, 謝亞芬, 台灣

目前「科學遊戲」在台灣科教界受到不少學者的重視，但是如何設計為教學，仍需要努力。本研究目的在探討以「光」的概念為教學內容，採用創造性問題解決 （Creative Problem Solving, CPS）為架構，設計融入科學遊戲的教學。教學對象為國小五年級學生，採用行動研究進行三回合的教學，並收集協同教師、學生的晤談與評量資料，做為修訂教 學以及評估學習成效的依據。研究結果如下：（1）CPS 可適當地做為融入科學遊戲教學的架構。（2）教學遭遇的問題主要為：活動設計、教學技巧、材料方面，本研究分別提出瞭解決方法。（3）評量結果顯示能有效提升學生的學習興趣。（4）教學者在教學活動設計、教學策略應用及研究能力等均獲得專業成長。最後本研究針對科學遊戲之教學活動設計、教學實施及未來研究方向提出數項建議。

3B – 2 (293) 利用「動手做」活動探討國小學童對重力概念的理解差異

作者: 陳燕嬋, 劉嘉茹, 台灣

本研究之主要目的在透過「動手做」的探究式教學活動設計來瞭解，國小學童對理解「重 力」此概念的前後差異。研究對象為自願參加並已修習過「力與運動」單元的國小 5 年級學童 30 名（平均年 齡 11 歲）。所有研究對象首先進行重力概念之問卷，活動進行後再進行概念測驗以瞭解學童對重力概念之前後理解的差異情形。活動進行方式則以實驗遊戲與實驗原理相互融合之發現式探究及實驗，能讓學生透過實際動手操作實驗的經驗，在課堂上進行主動探索，使學生由經驗及摸索的歷程中去建構出新的知識。本研究之資料分析蒐集由教師評量學童迷思概念的改變情形與知識的擴展，並透過學童自評、互評自己與同儕的學習。本研究結果發現學童藉著科學活動及實際動手操作產生了臨場感，不但可以引起注意，並讓學童進行批判思考。經由實際動手操作的學習環境，可提供學童較多實際經歷參與的學習機會，通過實際問題以及現象的分析，提升學童問題解決的能力。換句話說，學童以自己建構、解釋所學習得新的概念，教師同時引進新名詞或做概念澄清，使新概念應用於不同情境或擴展知識。

3B – 3 (372) Exploring children' understanding of the ecological concepts and its implication for environmental education

Author: TSOI Ka Ho, Hong Kong

Many shark speices are now threatened with extinction as a result of notorious sharkfin trading process and over-exploitation of marine resources under unlimited human desire. Their loss would be devastating to marine biodiversity and ecosystems. Many peoples are striving to save and protect these big fishes through different aspects, including scientific, economic and political ways. However, the recollection of my past experience inspired me that changing attitude of people, especially developing a positive attitude of children, is the most important factor in its success.

Many years before, a young boy told me that all sharks were bad guys so that he wanted to kill all of them. His alternative conceptions not only terrify me, but also arouse my study interest on what children think about the issues. The kid presenting such conceptions and attitude is believed to be the result of the lack of ecological knowledge background. Do the children really understand the sharks? Do they know the ecological role of sharks and their interaction with the other organisms in the ecosystem? Do they realize what the ecological consequences will be if all the sharks would be killed? We believe children having more understanding of the ecological knowledge should develop more commitment to environmental conservation and sustainability in their future.

This study aims to investigate children's (upper primary pupils) understanding of sharks and relevant issues in marine environment and identify any misconceptions. It also investigates the correlation between and the conceptual foundation of ecological science and the children's understanding of the environmental issues. The study is still in progress but some interesting findings can be observed from the preliminary results. If all sharks would be removed from the ecosystem, a quarter of 277 children believe that other fishes can live peacefully and harmonically, and 20% believe the biodiversity may be enriched. About 79% of children will show the change of their attitude from 'unlike sharks' to 'like sharks' if the flesh eaters would become herbivores and 38% of them believe sharks may shift their feeding mode from carnivore to herbivore. More than 87% believe every corner of the marine environment is full of life and more than 35% think that marine can provide us unlimited resources including main food source for human consumption. The results have significant implications for improving the current approach of environmental education.

Parallel Session 3C - Science Education in Life-wide/Authentic/Informal Contexts (課外或全方位的科學教育)

Date: 20 December 2010 (Monday)
Time: 17:00 - 18:00
Room 3: D2-LP-10

3C – 1 (254) 動物園生物多樣性教學對國小五年級學童學習影響之研究

作者: 施春輝, 賴慶三, 台灣

生物多樣性是人類生存與福祉的基礎，透過積極的維持生物多樣性，將保障人類永續生存的需要。臺北市立動物園是一個生物資源豐富的園區，也是一個適合進行生物多樣性學習體驗與休閒的絕佳場所。本研究之目的，透過進 行動物園生物多樣性的探究教學活動，探討對國小五年級學童生物多樣性概念與生物多樣性保育態度是否有影響。本研究以準實驗設計，以臺北縣某國小五年級兩班學童共 60 人為研究對象，在兩班中以 30 人為實驗組接受動物園生物多樣性教學活動，另 30 人則為對照組接受一般課室生物多樣性教學活動。本研究工具： (1)自編生物多樣性概念成就測驗，(2)自編生物多樣性保育態度量表作為評量工具(3)學習回饋意見表；工具一、二分別在兩組教學前後進行施測，藉以比 較兩組差異，工具三於實驗組在教學活動後施測，藉以瞭解實驗組學童對動物園教學之回饋。本研究結果如下，透過動物園生物多樣性教學活動的實施：(1)學童生物多樣性概念有增進效果，(2)學童生物多樣性保育態度有正向提升，(3)實驗組學習回饋資料顯示，實驗組學童生物多樣性的概念與保育態度均獲得顯著的提昇。

3C – 2 (233) 他們像科學家嗎? 高中學生於新興科技探究課程之探究能力表現的個案研究

作者: 陳毓凱, 洪振方, 台灣

強調透過科學探究進行學習是近年來科學教育的重要目標之一，以台灣而言，近年來教育部於高中職推行校本位的新興科(學)技探究課程，希望藉以提升學生的新興科學(技)素養與科學探究學習。本研究旨在探討四個台灣十年級學生所組成之個案小組，其在為期一年的新興科技探究課程裡所表現之科學探究能力及其特徵。本研究採個案研究法，而資料來源包含「觀察劄記」、「課室錄影錄音」、「學生半結構式晤談」以及研究者自編之「科學探究日誌」(涵蓋形成研究問題、實驗設計與執行、資料分析、形成研究結論以及反思研究等五個階 段)。資料分析採取研究者自編之「科學探究能力分析指標」，上述指標以科學探究日誌的五個階段為基礎並進一步劃分形成 12 項具體能力表現，此外，每一項能力表現又可以層次一至層次三(低水準至高水準)界定其水準。研究主要發現如下：(1)個案小組在不同階段所表現出的科學探究能力至少都可達層次二的表現水平，顯示該校發展之新興科技探究課程在學生的科學探究能力培養上有其成效；(2)學生所表現之科學探究能力仍與科學家之能力表現有所差距；(3)學生表現之科學探究能力受其對探究之觀感、個人信念以及先前經驗等因素之影響。相關討論將詳述於論文中。

3C – 3 (256) 從科學新聞到公民意識-以科學傳播為基礎的課程發展及教學應用

作者: 黃俊儒, 台灣

隨著時代的變遷及科技的日新月異，許多相關的研究不斷呼籲科學課程應該提供適切的科學知識及理解，以協助學生能夠閱讀與科學相關的報紙文章或報導，並且能與他人進行口頭的對話及文字的溝通。鑑此，本研究試圖結合科學教育及科學傳播（science communication）的相關論述，透過「科學新聞」作為媒介，以台灣的大學生為對象，開發適用於通識教育（general education）課程的教學模式，並評估其相關成效。

本研究從理論的探討開始，逐步地建構以科學新聞作為學習媒介的課程內涵，並實際必開設了「科學、新聞與生活」這一門課程。透過為期三年的研究計畫進行，過程中確立的整門課程的具體實施時程、單元內容及步驟，並同時透過質化及量化的方法，完成學生科學新聞閱讀特質的評估，並據以推估整體的學習成效。

研究結果發現，透過科學教育及科學傳播學理之間的融合所發展的教學策略，可以同步地提升學生的「科學素養」及「媒體素養」，尤其是對於科學及媒體背後之「超越內容知識」(content-transcending knowledge）的理解。這些特質對於台灣的社會公民在科技相關議題的參與而言，具有極為正向的助益。

Parallel Session 3D – Assessment of Students' Science Learning and Development (學生科學學習與發展的評估)

Date: 20 December 2010 (Monday)
Time: 17:00 - 18:00
Room 4: D1-LP-06

3D – 1 (202) 診斷原住民學生對科學文本「葉的構造與功能」之閱讀困難研究

作者: 廖斌吟, 楊文金, 葉佳承, 黃柏森, 台灣

本研究旨在探討台灣原住民(泰雅族，Atayal)學生對「葉的構造與功能」文本的閱讀困難情形。標的文本來自台灣現行國中科學教科書，文本共有 4 個文本句、18 個小句、字數為 259 字。研究資料的蒐集分為兩階段：第一階段以問卷方式蒐集 20 位元已學過標的文本的八年級泰雅族學生；第二階段選取 5 位通過「國民小學六年級閱讀理解篩選測驗」學生進行一對一訪談。訪談所採用之半結構式晤談大綱是依據系統功能語言學和漢語特性，分析標的文本後所編定。每位學生的訪談時間約 35 分鐘。研究發現每位學生平均圈選 4.5 個困難字詞，其中屬於參與者、環境成分、過程詞的困難字詞分別佔 60%、17%和 9%。此外，學生在過程詞(如：支持、橫切)、環境成份(如：間)和回溯零代詞的部份均遭遇閱讀困難，且難以理解小句內所論及的各項事物之間的關係(如：表皮細胞和表皮組織、表皮細胞和保衛細胞)。研究結果建議科學文本需要被適當地重新組織；同時，肩負科學文本之詮釋與解讀的科學教師須協助初學者熟悉科學語言。

3D – 2 (289) 台灣科技校院學生對科學相關議題態度之研究

作者: 曾元玨, 蔡俊彥, 黃台珠, 台灣

本研究旨在探討台灣科技校院學生對科學相關議題之態度，研究對象為南台灣三所科技校院學生，研究方法採用調查研究法，分析方法採量化研究並以交叉表分析。 在 114 份回收問卷中，扣除 11 份無效問卷，有效問卷為 103 份（90.3%）。研究結果發現：科技校院學生傾向支持「科學發展」、「暖化理論」及「生技研究」三種議題，而有較正向的科學相關議題之態度。(一) 在性別差異上，「支持科學經費」的議題男學生覺得目前政府花費「太少」而女學生則覺得「太多」，顯出了科技校院學生在「支持科學經費」態度上的性別差異。(二) 在修習高中科學課程差異上，是否修習高中科學課程可區隔科技校院學生對科學相關議題之態度，主要在「評估科學研究」及「支持生技研究」方面。(三) 在修習大學科學課程差異上，是否修習大學科學課程可區隔科技校院學生對科學相關議題之態度，主要在「支持科學發展」及「評估科學研究」方面。綜合以上結果，是否修習科學課程可藉以區別其對科學相關議題之態度，為提高學生科學相關議題之正向態度，教育單位在高中及大學課程中，除了專業科目的訓練外，尚應加入科普教育課程，以利提昇國民基本的科學素養及對科學與技術發展的支持度。

3D – 3 (362) 小學生科學課學習情況的調查和思考 - 以廣州市天河區為例

作者: 高淩飆, 馮翠典, 鄭雪萍, 詹茂榮, 中國

新課程改革將我國長期實行的小學自然課改為科學課，課程的定位、目標到內容的選擇都發生了很大的變化。新課程實施將近 10 年了， 小學生科學課學習的實際情況到底怎麼樣？弄清這一情況，有助於我們檢驗新課程的實施情況，判斷新課程的實際效果，為進一步深入進行課程改革提供參考。為此，我們對廣州市天河區小學生科學課學習情況進行了一次調查。

Parallel Session 4A - ICT in Science Education(科學教育與科技)

Date: 21 December 2010 (Tuesday)
Time: 11:00 – 12:00
Room 1: D2-LP-08

4A – 1 (204) 實物實驗與虛擬實驗促進學生科學探究能力之研究

作者: 蔡錕承, 張欣怡, 台灣

科學探究能力是學生實踐科學活動與獲得科學知識的重要能力，也是科學素養的重要指標 (National Research Council, 2000; 教育部,2003) ，如何培養學生的科學探究能力是許多研究關心的重點。本研究於台灣南部一所公立國民中學八年級一個班級、共32位學生，實施網路科學探究學習環境 (Web-based Inquiry Science Environment [WISE]) (Linn, 2006) 中的「溫度與熱」課程(Clark & Sampson, 2007; Chang, 2009) 。研究目的為探討網路課程中的實物實驗以及虛擬實驗於促進學生科學探究能力所扮演的角色。在實物與虛擬實驗中，學生經引導擷取研究問題、操作與控制實驗變 項、以及預測、觀察、與解釋實驗結果。該課程實施時間為一周，學生以兩人一組方式進行實物與虛擬實驗學習活動。本研究採用混合研究法(Johnson & Christensen, 2008)，探討學生經實物實驗與虛擬實驗學習活動，其科學探究能力之發展與改變。資料收集包含前後測驗、嵌入式評量與學生在實驗過程中電腦操作畫面與討 論錄影檔。研究發現經實物實驗與虛擬實驗學習後學生科學探究能力顯著提升。此外，實物與虛擬實驗分別促進不同面向之科學探究能力，學生亦有不同的學習表 現。基於研究結果，本研究討論使用虛擬實驗與實物實驗進行教學的適當時機、以及比較兩者於促進科學探究能力的優勢與限制。

4A – 2 (205) 國小自然與生活科技領域電子教科書融入教學之實施現況研究

作者: 彭文萱, 熊召弟, 台灣

數位新時代來臨，刺激教學型態改變，學習資源數位化也因應了時勢所趨。而各家教科書出版業者相繼推出電子教科書，強調同步及互動的教學設計，並且融入編寫、擷取及儲存等功能，促使教師融入教學使用。本研究旨在探討臺灣國小自然教師使用電子教科書之教學行為，希冀瞭解電子教科書融入自然與生活科技領域實施之現存問題，藉剖析現況提出研發的改進之道，並期許對於教學有所助益。研究採立意取樣，選擇於大臺北地區任教且有使用自然電子教科書進行教學 55 位教師為樣本，以自編的「國小自然電子教科書使用問卷」進行調查研究，並挑選其中 10 位教師進行深度訪談，以瞭解其使用電子教科書教學之行為。研究發現一般國小自然教師應用電子教科書教學時，大都以業者提供的文本電子化頁面及素材直接進行教學（63%），部分教師會利用編輯功能重新安排教學內容（33%）。綜合分析顯示電子教科書運用於教學的主要功能有：1.課本頁面展示及註記、2.多媒體影片或動畫的播放、3.連結網路資源、4.作為學生發表與分享的平臺等。於電子教科書改進空間的部分，教師則希望其開發可結合教學評量的功能，且具有人性化及多元化的設計。

4A – 3 (304) 計算機輔助物理實驗的低成本設計及教學實踐研究

作者: 吳肖, 周少娜, 楊友源, 中國

本文以香港學者基於音效卡所開發出來的科學教育多媒體 MMUSE（MultiMedia Utilities for Science Education) 此開源自由軟體為平臺，再針對目前中國大陸普通物理實驗的教學現狀，設計以單擺擺動為例子的低成本電腦輔助實驗。學生剛剛從高中進入大學，過去所接觸的單擺模型是擺長遠大於小球的直徑，擺角小於 5 度的單擺；他們以前測量單擺週期的工具也是採用碼錶多次計時；而且目前大陸許多高校的普通物理實驗課中的單擺實驗還是採用高中的實驗教學模式。我們以創新的實驗構想、活動和教學方法去拓展了學生能研究以前沒有研究過的問題，如研究"非常規"的單擺，小的擺長和大的擺角，以及當小球受到磁鐵作用時單擺週期變化情況等，並且嘗試引入科學探究學習。

此外，我們已經在中國大陸的沿海兩所不同背景的大學，對 85 名一年級的物理實驗課程學生進行教學實踐研究。通過對學生的前、後測和問卷調查、觀察學生的實驗行為以及訪談等研究方法，我們得出明確的證據：這麼樣的創新設計電腦輔助實驗是能以十分低廉的成本去有效地提升學生的實驗興趣、促進動手做實驗的基本技能和相關科學概念的深入理解。

Parallel Session 4B - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)

Date: 21 December 2010 (Tuesday)
Time: 11:00 – 12:00
Room 2: D2-LP-09

4B – 1 (135) 探尋促進北京郊區初中物理教師專業發展的有效途徑

作者: 盧慕稚, 中國

促進基礎教育教師的專業發展是提高教學品質、科教興國的重要途徑之一。21 世紀初，中國大陸啟動基礎教育課程改革實驗，對基礎教育教師專業發展提出了新的要求，也提供了促進教師專業發展的契機，本人自 2005 年以來，先後承擔了北京市 6 個遠郊區縣 10 多個初中物理教師新課程培訓班的課程設計與組織實施工作，為了探尋促進北京郊區初中物理教師專業發展的有效途徑，採取行動研究的方法，逐漸形成一套較為有效的培訓方案。

1。分析京郊地區初中物理教師的現實需求，將開闊視野、提供直接可參考的教學經驗與教學策略作為培訓內容主體，調動了教師參與培訓的積極性，形成努力學習、積極進取的研修氛圍，在借鑒、模仿中提高；

2。關注教師教學實踐中的問題，充分發揮教師隊伍中優秀者的示範作用。從真實情景中的具體問題切入，給予深入淺出的理論分析，從而引起廣大教師教學觀、學生觀的轉變；

3。提倡、指導教師在培訓中體驗學生的學習過程，反思自己的教學行為與教育理念，引導教師從被動接受在走向獨立思考、勇於創新。

4B – 2 (179) 美麗的塑膠花--打開自然領域輔導教教師心靈之行動研究

作者: 王純姬, 台灣

「科學教師之路：由實習輔導到專業成長」，是一條極具挑戰性的道路。

在朝向成為教師專業發展學校的歷程中，自然領域教師透過教師行動研究策略，在實習指導教授指導下，結合學校各級教師，包括：資深教師、資淺教師、新進教師和實習教師，組成「自然領域教學」專業成長工作坊，透過共同教學(co-teaching)、共同對話及同儕分享，形塑學習型組織，強化專業成長，共同針對：
(一) 提升資深教師輔助資淺教師於本身教學專業和實習輔導實習老師的能力、(二)提升新進和資淺教師輔導實習教師的相關專業能力、(三) 提升實習教師的專業知能，等三個面向進行探究。

作者將以質性研究方式呈現，在「自然領域教學」專業成長工作坊裡，實習輔導教師如何不斷的檢討、改進，全心投入與夥伴共同成長，強化專業承諾，豐富專業知識，打開輔導教師的心靈，完成提升實習教師專業知能的行動。

4B – 3 (170) 台灣原住民地區國小科學教師多元文觀點之專業發展

作者: 李暉, 台灣

本研究係從地方本位教育(Place-based Education)的觀點，邀集台灣東部六位原住民地區國小教師組成成長團體，經由參與，探究原住民族傳統智慧與自然科學的關係，發展課程以促進學童科學學習；並藉課程發展，培養科學教師多元文化觀點以促進其專業發展。

計畫採質性取向之協同行動研究(Collaborative Action Research)進行三年。收集資料包括訪談耆老、教師與學生，成長團體討論會記錄，教師省思劄記，活動錄影及其他文件資料。

研究發現在原住民族傳統知識的探究上，無論廣度與深度都比預想困難許多。在課程設計與實施上，原住民知識確實對學生科學學習造成影響；西方科學與原住民知識之整合課程可提高文化認同與學習效果；教師和耆老的協同授課方式有助於科學學習。對原住民學童而言，自然環境才是學習的主要場所，學習是生活中的實踐，是由體驗中產生問題及解決問題的過程。

在教師專業發展與信念改變上，教師在參與初期已開始逐漸瞭解原住民族的傳統智慧雖異於西方科學，但在處理地域性生活上卻常有獨到之處，此時在尊重另有文化的觀點上，都有明顯的改變；而產生改變之時間多半在參與的第二年末。換言之，改變的原因主要是因為參與而增加了瞭解，但是對於西方科學與原住民智慧在課程中應扮演的角色仍有不同看法。

Parallel Session 4C - Development of Science Curriculum (科學課程發展)

Date: 21 December 2010 (Tuesday)
Time: 11:00 – 12:00
Room 3: D2-LP-10

4C – 1 (94) 台灣離島奈米教育推廣案例探討

作者: 林仁輝, 陳錫添, 林弘萍, 黃台珠, 台灣

自 2002 年教育部「全國奈米科技人才培育計畫」起，臺灣奈米教育推廣已近 8 年，受限於距離因素，離島學生對奈米技術之感受性、需求性與達成奈米教育全國普及性等問題，有待探討。在一個台灣離島奈米科技推廣活動中，我們針對 130 餘位高中職學生做奈米相關知識推廣，並探討(1) 學員對不同教學方式如演講、實作/競賽、影帶等喜好程度、(2)與台灣的距離造成對奈米新知學習的限制、(3)學員對活動內容吸收程度等面向。

由活動滿意度調查、學習評量及遠距學習問卷等資料(有效問卷數，前測 129 份、期中 118 份、後測 126 份。)得知: (1) 98%參加學員表示想學習相關知識、但 9 成 2 學員自認學習奈米新知機會受限，最主要原因是對奈米本身不瞭解(68%)，或活動資訊不足(42%); (2)學員對活動辦理及內容滿意度均近 9 成，最滿意活動為實作及競賽(90%)，最不滿意活動為行程規劃(13%); (3)超過 9 成學員認為可幫助其在奈米學習並獲得新知，且有 9 成 1 學員希望能再有更多學習機會; (4)四道前後測重複出現問題，均呈現正確答題人數增加之趨勢; 其中，彩蝶效應答對率由 23%增至 81%。

4C – 2 (208) 中國內地的科學技術教育與科學課程改革 - 基於可持續發展的理念

作者: 楊寶山, 中國

本文系在中國內地（北京大學、清華大學、北京師大等 20 多所高校及北京、天津、上海等 20 多個省市）所做的課程改革進展調查的部分結論。在科學課程的標準、編制、實施和評價中始終基於可持續發展的理念是十分必要的，其中涉及科學知識、科學技術和科學文化等眾多方面。

一、科學知識的層面理解與本質把握

從知識的本質來看，學習科學知識應該基於知識的相對性、相關性和同一性三個層面。從學習的本質來看，學習科學知識應瞭解其相對性與相關性，從而把握其同一性。只有透過這樣的學習，才能真正領悟科學的本質。

二、科學技術的正面效應與負面影響

在教育理念層面，科學與技術分屬兩個不同質的概念，這需要在教育與課程中引起足夠的重視。在技術應用來看，前饋與後饋同等重要。在教育實踐層面，學校教育、媒體宣傳等需要辯證地理解科學技術的正面效應與負面影響的關係。

三、科學文化的傳統繼承與改革創新

在近期需要與長遠發展關係方面，需要整體考察科學、技術、社會及教育的互動影響。教育必須考慮對學生，從而對社會發展的長遠影響。在繼承傳統與改革創新關係方面，需要巨集觀把握廣義的文化觀、教育觀、科學觀和價值觀。

4C – 3 (231) 台灣 K-12 奈米科技教育課程指標之建構歷程

作者: 熊召弟, 趙毓圻, 台灣

本研究透過台灣第一期奈米科技教育計畫六年（2003 年至 2008 年）間，由 K-12 奈米種子教師所發展之奈米教材發現其中的潛在課程結構，並以此結果為基礎建構台灣 K-12 奈米科技教育課程指標。「內容分析階段」收集全台灣五個奈米科技 K-12 教育發展中心之 209 份教材與教案，以「奈米尺度科學與工程 重要概念」(Stevens, Sutherland, & Krajcik, 2009)形成內容分析檢核表，並經由電腦計數方式尋找各概念向度出現頻率及關連性；「指標發展階段」依據內容分析發現之教材缺失，如部份向度比重偏低、 教材設計在學習階段的重複、不符合學習階段等，進一步對應「國民中小學九年一貫課程綱要」、「普通高級中學課程綱要」和國內外相關文獻，以九個主向度完成「奈米科技教育課程指標調查」原始卷，經三次共 16 位專家滾動式焦點團體諮詢會議、28 位專家個別修訂，持續修正奈米科技課程指標之次向度、年段指標等敘述，完成「奈米科技教育課程指標調查問卷」後，收集 27 名專家問卷調查結果，再由研究團隊召開兩次專家代表諮詢會議，輔以四次奈米科技教育教學觀摩，形成重視效度(validity)與學習進程(learning progress)的奈米科技課程指標的內容敘述及其學習進程圖。本研究所發展之「K-12 奈米科技教育課程指標」，可提供教師設計奈米科技教學單元的參考依據。

Parallel Session 4D - Learning and Teaching Science (科學教學策略)

Date: 21 December 2010 (Tuesday)
Time: 11:00 – 12:00
Room 4: D1-LP-06

4D – 1 (337) Wiki 在教育方面的應用研究

作者: 盧德元, 中國

"Wiki"一詞源於夏威夷語"wee kee wee kee",意思是"快點快點"。它是一種協作式的知識管理工具。它的出現為知識生產提供了一個新的模式,也就是知識的規模合作生產、管理與積累。本文通過相關文獻和幾個典型的 wiki 案例,來探討 wiki 在教育資源共創、跨學科協作等方面的優勢以及在資源管理、Wiki 軟體建設現狀、版權問題方面所遇到的問題。wiki 在教育教學領域中的應用研究才剛剛起步,只要能揚長避短,wiki 的應用前景值得期待。

4D - 2 (167) 以臆測為中心的數學寫作活動對學生數學素養影響歷程之研究

作者: 秦爾聰, 賴紀寧, 台灣

本研究旨在探討於國中課室中實施以臆測為中心的數學寫作活動,對個案學生數學素養的影響歷程,並歸納學生在不同寫作類型與臆測階段展現之數學素養的主要面向。

研究對象為作者之一任教的七年級班級中所選取之兩名低成就學生、一名中成就學生與一名高成就學生。資料蒐集包括數學寫作活動單、學生單元活動回饋單、教師反思日誌、課室觀察錄影轉錄資料以及晤談轉錄資料等,並以質性研究的方式分析個案學生在三次循環階段數學素養的改變情形。

研究結果顯示:(一)不同背景學生數學素養的改變歷程為:(1)高解題動機的低成就學生透過合作學習提升概念理解、策略應用和適性推理能力,學業成績進步至高成就之列;(2)高成就學生在三次循環皆展現高度的策略應用和適性推理能力;(3)中成就學生透過臆測任務啟動適性推理能力,並漸進展現概念理解、策略應用以及建設性傾向;(4)低成就學生以相信或反駁他人想法為臆測起點,逐漸展現概念理解、適性推理能力和建設性傾向。(二)學生在不同數學寫作類型與臆測階段數學素養的展現情形為:(1)解釋性寫作/猜測階段促進學生概念理解和策略應用的交織展現;(2)學生在解釋性寫作/檢驗、討論整理以及偵錯式寫作/相信反駁、結論等四個階段展現不同層次的適性推理能力;(3)擬題寫作/臆測循環階段以策略應用的展現最為顯著;(4)總結式寫作/回顧反思階段促進學生概念理解、策略應用以及建設性傾向的發展。

4D – 3 (235) 學生在科學探究中的思維方式研究

作者: 鐘媚, 中國

通過科學探究促進學生對科學本質的理解,培養學生的科學思維能力,是當前科學課程改革的重要議題。在分析學生如何進行觀察、假設和策劃,Harlen (2000) 認為這些探究過程技巧的證據不需要在現場收集,透過學生的書面工作很多時候能提供有用的資訊。本研究將基於 Gott & Duggan(1995)和 Gott & Robert(2008)提出的證據觀(concept of evidence)模型,對小學生的科學專題探究計畫和報告進行分析。研究發現,雖然學生經歷了完整的科學探究過程,卻不一定能內化科學的思維方式,反之出現了各種似是而非的想法和做法,包括:1)無法將探究意念轉化為可探究的問題;2)探究設計偏離所提出的探究問題;3)不能在實質意義上理解公平測試的原理;4)觀察測量過程不能獲得可靠的證據資料;5)將探究結果隨意擴展到證據以外;6)以模棱兩可的方式回避反例證據等等。為此,重視培養學生的證據觀,鼓勵辯護論證是今後科學探究教學需要關注的問題。

Parallel Session 4E - Science Education in Life-wide/Authentic/Informal Contexts (課外或全方位的科學教育)

Date: 21 December 2010 (Tuesday)
Time: 11:00 – 12:00
Room 5: D1-LP-07

4E – 1 (104) The application of community service learning on higher science education

Authors: NG Ling Ling Betsy, YAP Kueh Chin, HOH Yin Kiong, Singapore

Learning of science has been traditionally conducted in classrooms or in the form of lectures. Science education is usually context-specific learning as students are taught a particular module of content in class. In problem-based learning, they are provided with examples of problems in which they learn how to solve these types of problems. However, when students encounter a similar problem in a different context, they are unable to apply their prior knowledge to this new situation. The key components of authentic science learning are the external world and the individuals. Although the classroom aims to retain such authenticity by providing real-life problems to solve, it will never be the same as students' personal experiences in the real world – the community service learning (CSL). CSL integrates science learning into the real-world situations within a community context. It is one of the active learning strategies that aims to foster better understanding of course content and broader appreciation of the discipline. This CSL study focuses on the community service project and the individual critical reflection. CSL provides a real-life working environment that lead to excellent learning outcomes for the students as well as strengthens their individual social responsibility. This paper provides an example of the application of CSL within a tertiary institutional context. The CSL project involved student volunteers to set up a bioreactor for biogas supply within a local community of Chiang Rai, Thailand. In particular, it demonstrates students' reflection and their personal experiences in learning science beyond the classroom. Based on quantitative and qualitative data from 22 participants, it demonstrates the meaningful impact of CSL on student learning outcomes. Results show CSL creates an active yet meaningful learning of science and socially responsible citizens. Finally, this paper will also discuss the implications of learning science in an informal yet authentic context.

4E – 2 (149) Development of a Parent's Guide for the Singapore Primary Science Curriculum: empowering parents as facilitators of their children's science learning outside the formal classrooms

Author: LEE Ai Noi, Singapore

Parents can play a vital and active role in facilitating their children's science learning outside the formal classrooms. Parental involvement in their children's science learning process not only could enhance their children's learning motivation and interest in science, it also could help to strengthen the family bond when parents and children learn together. This paper describes the development of a Parent's Guide to complement and support the Singapore Primary Science Curriculum (from primary levels 3 to 6). The guide aims to empower the parents of Singapore primary school children as facilitators of their children's science learning to reinforce science concepts and develop their children's creative thinking and process skills outside the science classrooms. The guide provides the parents with step-by-step hands-on activities and simple science ideas from the everyday life environments together with inquiry-based questioning techniques to enable parents to facilitate their children's learning of science at home and in other informal settings. In this paper, the author will provide a brief background to and the rationale for the development of the Parent's Guide. This will be followed by an in-depth discussion of the activity-based science tasks and questions designed for the Parent's Guide in alignment with the Singapore Primary Science Curriculum as well as the theoretical perspectives underlying the development of these science tasks and questions for the learning of science in informal contexts. Implications of the development of the Parent's Guide as well as the empowerment of parents as facilitators of children's science learning outside the formal science classrooms will also be discussed.

4E – 3 (345) Spatial ability in understanding astronomy concepts

Author: KWOK Ping Wai, Hong Kong

Research findings in science education (Pallrand & Seeber, 1984; Coleman & Gotch, 1998; Mathewson, 1999) indicate that some students encounter difficulties in learning certain science concepts which are related to spatial thinking. In the area of astronomy, the explanation of retrograde motion of planets using geocentric and heliocentric models, the technique of parallax in measuring distance, the structure of the Milky Way inferred from the distribution stars are just a few examples of astronomy concepts that require spatial ability to understand. The study explores the relation between spatial ability and the learning of science concepts particularly related to astronomy. Linn and Petersen (1985) define spatial ability into 3 categories: spatial perception, mental rotation and spatial visualization. Spatial perception is measured by the Group Embedded Figures Test (GEFT) (Witkin et al, 2002). Mental rotation ability is measured by the Purdue Visualization of Rotations (ROT) test. (Bodner & Guay, 1997). Spatial visualization is measured by test such as Paper Folding, Form Board, and Surface Development (Linn and Petersen 1985). Besides measuring the spatial ability, science concepts of the students are also tested so that the performance can be correlated with the spatial ability. Astronomy Diagnostic Test (Zeilik, & Morris-Dueer, V. J. 2004) is used to measure conceptual understanding of astronomy. When this is related to their spatial ability, we can identify the misconceptions and conceptual difficulties that students have and the spatial elements that cause such difficulties.

Parallel Session 4F – Assessment of Students' Science Learning and Development (學生科學學習與發展的評估)

Date: 21 December 2010 (Tuesday)
Time: 11:00 – 12:00
Room 6: D1-LP-08

4F – 1 (251) 廣州市初中生物學科開放式考查的實踐與探索

作者: 馬學軍, 中國

教學評價是教學過程的重要組成部分。過往的學科階段性或終結性評價,通常採用以考試為基礎的評價機制,以紙筆考試形式為主,以量化的分數為呈現方式。這種方式,側重對學生在認知領域上的評價,全面性、發展性不足。近年來,廣州市生物學科順應課程改革的發展方向,嘗試建立促進學生素質全面發展的評價體系,在初中實施"開放式考查",在教學中產生了積極影響。

初中生物開放式考查,是一種任務型的考查方式。這種評價方式,能夠測量理解、思維技能和其他複雜的學習成果,特別強調組織、整合及有效表達思想的能力,鼓勵學生關注整體的知識內容和探究技能的發展。它以促進師生發展為宗旨,注重教學過程,強調質性評價,提倡評價目標與主體多元,強調參與和互動,關注個體差異等特徵。它以質性評價為主要形式,側重考查學生的多元智力,力求體現評價的靈活性、考查形式的多樣性和選擇性。考查要求學生在七年級和八年級兩個學年內,依據《生物課程標準(實驗稿)》和教材內容,選擇一項適合其個性特長的專案,參照學習主題(如"健康的生活"、"人與生物圈"等)開展研究,並以"作品"(包括探究報告、調查報告、實驗報告、小論文等)為呈現方式,提交給學習夥伴和教師進行評價。

4F – 2 (303) 台灣五年級學童太陽系學習成效之分析研究

作者: 吳季玲, 台灣

太陽系的學習無論是對國小學童、國、高中學生、甚至是對教師或一般大眾來講,都是一項挑戰。但學童所能獲得有關太陽系的訊息相當多,且這些訊息往往圖文並茂。在教師利用教學檔案對五年級學童進行太陽系的教學後,本研究試圖瞭解 1.學童對學習內容是否照單全收?抑或有較為關注的學習內容。2.太陽系中哪些次概念的學習對學童而言較為困難?3.圖、文所呈現的學習內容中,學生對於哪種表徵所呈現的訊息有較佳之學習成效?4.檔案中不同表徵的呈現,是否也影響學生記錄的表徵型態。分析學童自由完成的學習紀錄單後發現:1.學童對於各星球表面溫度的差異最感興趣、印象最深刻;其次為八大行星的排序與軌跡;接著為各星球之大小比例及公轉、自轉所需之時間。2.學童對於八大行星的大小及運行軌道的學習有明顯的困難。3.學生對於文字所呈現的教學內容掌握的情形較佳,對於圖所呈現的內容則較為忽略。4.學童所呈現出來的表徵與教學內容中所使用的表徵大致相符合,僅少數的學生會將圖、文的表徵轉換成表格來呈現。

1F – 3 (234) 國中學生對「分為」一詞之語意理解

作者: 楊文金, 范賢娟, 葉佳承, 李哲迪, 台灣

本研究旨在探討科學文本中「分為」一詞用在表達「類別」或「組成」意義時,讀者理解的情況。科學文本有不同的形態,「組織科學」屬最基本的方式,而「類別- 組成」則是其中常見的論述。「分為」一詞剛好同時具有此二種意義,過去的研究顯示讀者理解的方式值得探究(楊文金,2007;楊文金,2010)。本研究以臺北縣市 6 校 12 班的八年級 360 名學生為研究對象,隨機發出三份問卷,一份是用抽象的語詞「A 可分為 B、C 和 D 三類」與「A 可分為 B、C 和 D 三個部分」,第二份是「類別」的內容,但 A, B, C, 與 D 則用生物或地科的類別方式來套用,第三份是「組成」的內容,類似地換成生物或地科的組成。問卷根據每一項敘述表達四項事物的關係,列出 13 種解釋方式,請受試者判斷此 13 個解釋的正確程度。研究結果發現:「分為」一詞在事物關係判斷上的確具有相當大的歧異度,既可當「類別」解,也可當「組成」用,在抽象句式當中即使有外顯特徵明示其意義,但學生區辨能力不足;在具有科學內涵的句式當中,學生則較能明顯判斷出該詞在句中的意義,做出符合科學內涵的解釋;在類別的科學內容中,似乎容易被視為可用從部分談到整體的組成敘述(B 是 A 的組成,C 是 A 的組成,D 也是 A 的組成)來解釋。本研究顯示類別與組成的關係,並非如一般人所認為的單純易懂,其中有很多細節值得深入探討,對這方面問題的釐清,可作為科學文本編寫的參考。

Parallel Session 5A - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)

Date: 21 December 2010 (Tuesday)
Time: 15:00 – 16:00
Room 1: D2-LP-08

5A – 1 (248) 策劃專題研習及顧問老師領導的分享

作者: 周水英, 黃偉強, 賴子琪, 香港

專題研習是課程改革的四個關鍵項目之一，重點是幫助學生發展獨立學習的能力。專題研習是一項有效學習策略，可跨學習領域推行。學生更可以透過專題研習，主動地建構知識及應用於生活中。本校 2010 年度專題研習透過跨學習領域合作推行，中三的級研習主題為「綠色生活你我他」，希望同學能將綜合科學及數學領域知識融會貫通，並建構知識應用於學習上。

透過本文案例，可分享老師於專題研習中如何促進學生自主的學習。從同學滙報的感想及結語，給老師的驚喜同學能善用共通能力去建構知識並應用於生活中。

設計專題研習課程成與敗，關鍵在於一個成功的課程策劃領導。課程統籌需負責規劃出研習的進度時間表，資源管理及編配、老師校內培訓及安排考察活動時間、口頭滙報及成果分享等工作。但最重要的統籌工作是如何協調各科減少老師及同學的課業負荷及有效地分配資源。

顧問老師按規劃的進度，會見同學討論進程。就著主題，引導學生用不同角度看「綠色生活」去設定副題，例如「空中花園」、「廢氣五日行」等。顧問老師在文中也會分享如何解決進程中的困難，例如如何補救種植的實驗植物死亡。

5A – 2 (176) 回看臺灣科學教育師資培育體系：三位資深科學教育師資培育工作者訪談分析

作者: 熊同鑫, 楊書毓, 台灣

臺灣於 1994 年師資培育走向多元開放政策，師範學院為生存開始擴增規模，在 2001 年前後，開始設置自然科學教育系。2003 年國小教師供需失衡浮現，師資培育政策走向緊縮。2005 年師院均改制為一般或教育大學，九個自然科學教育系，僅剩國立臺北教育大學保有原系名，餘均更名或轉型；臺灣的國小自然科學師資培育體系走向萎縮。本篇訪談三位資深科學教育工作者，敘述他們看見的近半世紀師資培育體制變化，包括科學教育發展與師資培育，並對現行狀況提出建議。

三位受訪者認為在師範學校和師專時期是屬於博雅教育，重視「良師興國」的師範精神，但未特別重視科學教育，一則校內科學師資水準不齊，二則國小師資為通才培育。師院時期，始以「系」進行分科培育，受訪者認為對職前教師的專業知能養成有幫助，但在教師素養方面則語帶保留，認為師範精神已削弱。面對現況，受訪者指出師資培育學程化後，師資生的教育基本素養和學科專業有雙弱的現象，教師素質有下降的隱憂。對於科學教育未來的發展，受訪者認為包班制不變之下，應從培養「級任老師的能力，專業科目的特色」出發，改變體制為三加二制，以能強化職前教師的教育素養與專業能力。

5A – 3 (349) 浙江省科學教師與學生的科學本質觀之調查與層因分析

作者: 黃曉, 中國

以 McComas 基於八個國家的科學教育標準提出的科學本質 14 個方面為依據，依據大陸科學教育所處的國情設計“科學本質觀”調查的問卷，即從科學的相對性與絕對性，主觀性與客觀性，實踐性與創造性，科學定律與科學理論，科學與社會、文化的相互作用，科學研究方法的多樣性六個層面體現。問卷的信度採用 SPSS17.0 進行信度分析，得 Cronbach's α 係數為 0.764，即信度良好。

問卷的調查物件選擇了浙江省的 50 名教師與 329 名學生，問卷的分析採用定量與定性分析的結合。即從男女教師、學生對六個層面各問題的回答平均值差異比較、回答“同意”、“不同意”、“無法確定”的百分率進行定量分析，結合對主觀題的回答之定性分析，明確科學教師與學生的科學本質觀。

從結果分析可見，儘管現有諸多的文獻呈現科學的相對性、主觀性一面，但科學的絕對性——科學即是真理、客觀性——科學研究是獨立於社會、經濟、文化等因素，科學研究成果是不受科學家、研究目的影響——這些有關科學本質的事實，對教師與學生的影響都極為深刻。在科學研究是為了尋找獨立于社會與文化的客觀事實與真理的回答中，更表現出一種主觀性與客觀性的徘徊。儘管科學定律與理論如同科學概念一樣是教師與學生們常見的字眼，但表中呈現一半的教師與多數的學生無法確定科學定律與科學理論是否不同，即無法真正理解何為科學定律、科學理論及其區別。在科學方法層面，諸多的教師與學生認識到了直覺、想像力等在科學研究中的作用，也意識到觀察不是科學知識獲得的唯一方法，但針對某種具體的科學方法（如模型、類比等）、科學研究的過程，無法對其涵義有確切的理解與適當的應用。此外，師生在對科學本質觀中表現出的性別差異呈現不同。論文進一步試圖從教育的週邊因素與教育的內在因素分展層因分析。

Parallel Session 5B - Learning and Teaching Science (科學教學策略)
Date: 21 December 2010 (Tuesday)
Time: 15:00 – 16:00
Room 2: D2-LP-09

5B - 1 (136) 小學科學探究式教學的八個環節的提出

作者: 孟令紅, 中國

為了更加有效地落實科學（3～6 年級）課程標準所提倡的探究式教學，加強小學科學探究式教學的可操作性，通過小學科學課堂教學實踐的嘗試研究，針對課程標準中提出的科學探究的提出問題，猜想與假設，制定計劃，觀察、實驗、製作，搜集整理資訊，思考與結論，表達與交流的七個環節，梳理為以下八個環節。即1.提出問題；2.作出假設；3.制定計劃；4.實施計畫；5.記錄結果；6.得出結論；7.表達與交流；8.完善結論。說明兩者的不同主要是後者增加了"記錄結果"和"完善結論"兩個環節，並說明了增加這兩個環節的理由。還以"如何使小燈泡更亮些？"的具體實例說明小學科學探究式教學的八個環節的實際應用。最後，總結出適合小學科學探究式教學的八個環節的內容選擇原則至少要考慮以下三點。1.設置的科學探究活動的情景一定是學生所熟悉的，並且能夠提出真實問題；2.盡可能讓學生通過體驗科學探究活動的過程，自己能夠總結出真正理解的、具有一定證據支撐的結論（即使可能是不完全正確的）；3.影響科學探究問題的因素不要太多，並且能夠有效地進行控制。

5B – 2 (199) 臆測為中心之數學教學活動設計—以數列與級數為例

作者: 秦爾聰, 簡大為, 李立凱, 台灣

本研究目的在發展以臆測為中心之「數列與級數」單元的教學活動設計，研究設計的理念包括：（1）以 RME 理論為原則選擇教材內容，由學生想像得到的情境為 出發；（2）利用錯誤命題、正確命題與學生提出猜想等方式設計學習任務來啟動學生形成猜想；（3）以猜測、反駁、檢驗與相信，作為學生臆測思維模式的四個定點站；（4）透過獨立思考－小組溝通－獨立判斷－全班討論作為臆測活動的進行方式。研究的設計依據發展研究法(Gravemeijer, 2004)的三大關鍵步驟：發展初步的設計、實施教學實驗、進行回溯分析，將研究流程以三個循環來進行。第一次循環先參考 MiC 教材、NAEP 測驗以及台灣教育部編版教科書等教材，透過內容分析法進行整理、篩選與分析，並根據台灣九年一貫能力指標及規劃學生假設性學習軌道(hypothetical learning trajectory [HLT], Simon, 1995)來設計相對應之學習任務，初步完成的活動設計透過由數教學者、博碩士班研究生與在職教師組成的研究群進行思考實驗（thought experiment）的討論，然後由研究者針對 C1 班級進行第一次教學實驗；第二次循環首先針對第一次教學實驗的結果於研究群中進行回溯分析，接著再由同一研究者針對 C2 班級進行第二次教學實驗；第三次循環則針對第二次教學實驗之結果先進行回溯分析，然後將修正後的教學活動設計委請一位合作教師對 C3 班級進行教學，研究者則以參與觀察者之角色進行課室觀察，最後將完整教案做最後的修正與精緻化。

5B – 3 (328) 創造性科學問題提出能力的發展及影響研究

作者: 韓琴, 中國

創造性科學問題提出能力是科學教育的重要組成部分，同時也是創造力的重要組成部分，研究創造性科學問題提出能力不僅有助於豐富創造力理論，而且可以為科學教育提供。本文兼顧認知變數與社會性變數，以小學四、五年級的學生及教師為研究物件，綜合採用了問卷、測量、訪談、實驗室實驗、教學實驗、課堂教學實錄分析等多種方法，研究了小學生創造性科學問題提出能力的發展及影響因素。研究的主要結論如下：

一、小學生創造性科學問題提出能力整體呈上升趨勢，小學四年級學生是創造性科學問題提出能力發展的"質變"時期；

二、男女生的創造性科學問題提出能力發展趨勢基本相同；不同類型學校的小學生創造性科學問題提出能力發展趨勢大致相同；

三、不同的學習方式對學生創造性科學問題提出能力的影響不同，同伴互動學習後完成創造性問題提出任務的效果顯著優於學生獨立學習後完成任務的效果。

四、小組成員結構對學生創造性科學問題提出存在顯著的影響，自選組學生完成任務的效果最好。

五、小組成員結構對不同能力學生創造性問題提出能力的影響不同。

Parallel Session 5C - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)

Date: 21 December 2010 (Tuesday)
Time: 15:00 – 16:00
Room 3: D2-LP-10

5C – 1 (348) An preliminary investigation into critical thinking of in-service and pre-service middle school chemistry teachers in Shaanxi province of China

Authors: ZHOU Qing, XING Li Juan, WANG Yan, China

This paper investigated the development of critical thinking of middle school chemistry teachers in Shaanxi province of China. Critical thinking has become increasingly prominent for chemistry teachers in China. In this paper, in-service and pre-service teachers' critical thinking is examined in order to provide evidence for establishing teachers' standard. The volunteer sample in this study consisted of 69 in-service and 61 pre-service chemistry teachers. It presents the assessment of the teachers' two components of critical thinking: dispositions towards critical thinking and critical thinking skills. The California Critical Thinking Disposition Inventory (CCTDI) and California Critical Thinking Skills Test (CCTST) were used to assess the teachers' critical thinking. The data was analyzed using descriptive statistical analysis techniques, arithmetic mean, standard deviation and t-tests. Overall, the results of this study indicated that the teacher' dispositions toward critical thinking are at an average level while their critical thinking skills are very slow, which strongly urges us to recognize that the actuality of critical thinking development of the high school teachers in the Chinese city of Xi'an is not optimal.. This research also shows there are statistically significant differences between in-service teachers and pre-service in their critical thinking skills (t=-3.174, p=0.002), compared with no significant difference in their critical thinking dispositions (t = 0.474, p=0.636). We can see that there are no differences between in-service teachers and pre-service in critical thinking dispositions but there are significant differences in critical thinking skills, which challenges teacher educators to cultivate both critical thinking dispositions and critical thinking skills of teachers in different majors purposefully but discriminatively by reforming their teaching or even curriculum setting; Additionally, both CCTST and CCTDI mean scores reflect that the pre-service chemistry teachers performed better than the in-service teachers toward critical thinking, which urges the in-service chemistry teachers to pay attention to critical thinking. We are anglicizing the reasons why it presents.

5C – 2 (358) A descriptive study of three pre-service teachers' understanding and practice of argumentation in science classroom

Authors: XIE Qun, SO Wing Mui, China

Argumentation is recognized as the core practice in science teaching, as well as an essential goal of science education. And teacher is the key factor in organizing argumentative discourse in science classrooms. Composing argumentation in science classrooms requires teachers not only understanding the role of argumentation in science classrooms but also development of strategies for effective implementation. The purpose of this paper is to examine pre-service teachers' understanding and practice of argumentation in science teaching. Three pre-service science teachers participated in this program. They take science lessons in secondary schools for two months for teaching practice. Their understanding and practice of argumentation in science classroom are measured at the beginning of the teaching practice. The study examines the following three aspects of pre-service teacher behavior related to argumentation in science teaching: the understanding of argumentation in science education, the epistemic levels in argumentation in lesson planning, and the teaching practice of argumentation in science classroom. The current understanding and practice of argumentation of pre-service science teachers is a reflection of their past education. Survey and interview data collected for this study includes three pre-service science teachers' understanding of component and characteristics of argumentation and the role of argumentation in science teaching, the ability of composing argumentation while facing scientific questions, and the argumentative discourse in their science classroom. The two frameworks for analysis used in this study are: a) Toulmin's model which is used to analyze the structure of argumentation, and b) Osborne's model which used to analysis the quality of argumentation quality. The study finds that teachers' understanding and ability of composing argumentation affects their practice of argumentation in science classroom. It is also found that though all three pre-service teachers did not experienced systematic instruction of argumentation theory in science education, they have tried to organize argumentation in their science classrooms. Last but not least, challenges and pressures faced by the teachers while composing argumentation are discussed.

5C – 3 (367) The design and implementation of elementary science methods class instruction in the U.S. Colleges and Universities

Author: LEE Carole, United States

This study employs a qualitative approach to understand the existing situations of preservice elementary teachers (PET) prepared to teach science in the U.S. Research questions were: 1) What goals do teacher educators express with respect to the preparation of PET for teaching of science? 2) What components of methods classes are related to each of Feiman-Nemser's conceptual orientations in teacher education? 3) What specific science knowledge or skills are emphasized in the methods classes? 4) What challenges do teacher educators reveal when they plan and teach science in the methods classes?

To fully understand the teacher educators' goals with respect to the preparation of PET to teach science, an ethnographic approach of multiple case studies were employed. The descriptive processes of the 16 cases were conducted through face-to-face interviews, lesson observations and examination of the syllabi and textbooks used. The data were collected in the fall and spring semesters of 2009-2010. During the field visits, the researcher also collected information on the academic and teaching experiences of the teacher educators as the teacher educators' experiences might affect the way how they teach. The transcription of the interviews and lesson observations were sent to all participated teacher educators for member checking.

The findings reveal the complexities and diverse nature of the method classes. Answers to Q1; The goal for most teacher educators was to prepare PET not to be afraid of science and have confidence in teaching science. Answers to Q2 & 3; Among the lesson observations, only six lessons were focused on science content and pedagogical knowledge. Results showed that the teacher educators of these six institutions had a natural science or science education academic background. Only five methods classes were focused in science instruction, the others were on integration of teaching science and math, or on a blended curriculum. During the lesson observations, a lot of teacher educators modeled the use of hands-on activities, hoping that PET would exhibit the same practice in schools. Other teaching strategies used were the use of children's literature and integration of math and other disciplines. When considering the science content knowledge, most teacher educators talked about science in personal and social perspectives but not on the nature of science even though the nature of science is mentioned in the National Science Education Standards (NRC, 1996). As for the science inquiry, most teacher educators thought that inquiry occurs naturally whenever hands-on activities are done. During lesson observations, several teacher educators focused on doing the activities without discussing the science knowledge. Answers to Q4; The challenges that teacher educators encountered were: small number of enrollment, preservice teachers' diversity in science knowledge and the short duration of methods class.

This study offers valuable insights not only to the Arkansas Department of Education but to other states as well, that the science content knowledge and pedagogy are equally important in the preparation of PET to teach science and certain core "ideal" elements should be included in the teacher education program.

Parallel Session 5D - Historical, Philosophical, Social, Cultural, and Gender Issues (與科學教育有關的歷史、哲學、社會、文化和性別事宜)

Date: 21 December 2010 (Tuesday)
Time: 15:00 – 16:00
Room 4: D1-LP-06

5D – 1 (356) 近十年國外科學教育中 HPS 教育研究的文獻計量學分析 - 以 Science & Education 為例

作者: 林長春, 杜紅, 中國

本文以專門刊登有關 HPS 教育論文的國際著名科學教育期刊——Science & Education 為例，對該期刊 1998－2007 年間發表的論文進行文獻計量學分析，以便我國科學教育工作者瞭解和把握國際科學教育研究在該領域的發展及趨勢，從而推進我國科學教育中 HPS 教育的研究，為我國當前的基礎教育科學課程與教學改革實踐提供借鑒。本文從文獻載文量、篇密度、文獻作者總數、篇均人數、文獻作者、文獻內容以及發展趨勢等方面進行了統計分析，結果表明：（1）該期刊近十年來刊發的文獻作者中，美國占了絕對優勢。西班牙、希臘、澳大利亞、英國、巴西、阿根廷、以色列、加拿大、義大利、德國等國在該領域也有相當的學者發表了研究成果，而中國大陸則沒有作者在其發表論文。(2) HPS 教育的三大主題即科學史、科學哲學和科學社會學與科學教育的研究格局在十年內沒有明顯的變化，但科學哲學和科學史(包括科學本質、科學方法論和認識論）是研究的熱點，值得關注。(3) 在相關學科課程的 HPS 教育研究方面，以物理課程開展的相關研究最多，其次是化學、數學、生物學、天文學和地理學。

5D – 2 (124) 因果解釋在科學教科書中的取向-以牛頓力學與演化論為例

作者: 蔣佳玲, 台灣

因果關係是人們認識世界與解釋事物發展變化的一種方式。自然科學領域中，科學家透過理論或實驗的方式，努力尋求對自然現象進行因果解釋。Einstein 認為，西方科學建立在以因果律為基礎的形式邏輯之上。因此，當量子力學從或然率的角度切入時，對於物理的衝擊，就不僅僅只是科學理論上的不同，而是更為深入的、對於因果律(causality)信念的爭論。

然而，不同領域的科學並非採取相同取向的因果解釋。例如演化論沒辦法藉由「設定前件、觀察後件有無出現」的方式進行驗證，所以演化論採取的是歷史因果解釋。科學理論有著不同的因果解釋取向，那麼科學教科書中的因果解釋也會有不同的取向嗎？

本研究以牛頓力學與演化論為例，以內容分析的方式比較台灣 7、8 年級科學教科書，分析此二單元所呈現之因果解釋取向。結果顯示，牛頓力學與演化論雖然都涉及了因果解釋，但解釋的本質十分不同：牛頓力學的解釋是單因多果，演化論的解釋是多因單果。此外，牛頓力學單元中許多陳述是全稱命題，但在演化論單元中卻有諸如「推測」、「科學家認為」等詞彙出現。在舉例方面，牛頓力學偏向以定律「解釋」現代生活與科技實例；演化論則傾向以歷史案例來「說明」理論。

Parallel Session 5E – Assessment of Students' Science Learning and Development (學生科學學習與發展的評估)

Date: 21 December 2010 (Tuesday)
Time: 15:00 – 16:00
Room 5: D1-LP-07

5E – 1 (203) Development of an instrument for measuring elementary students' science oral expression

Authors: LIN Sheau-Wen, LIU Yu, CHEN Shin-Feng, WANG Jing-Ru, KAO Huey-Lien, Taiwan

The purpose of this study was to develop an instrument for measuring elementary students' science oral expression. The instrument development procedure had three general steps: defining the components of science literacy regarding oral expression in science lessons, collecting discourse of science lessons, and instrument development. Classroom discourse were collected from videotapes of inquiry approach science lessons. The data were used to develop 36 open-ended items belonging to three components of scientific literacy: identifying questions, designing methods, and drawing evidence-based conclusion. The science oral expression test was divided into two sections and administered to 317 students that were selected through cluster sampling from 4th and 6th graders. Difficulty indices ranged from 0.19 to 0.86 and 0.10 to 0.84, and discrimination indices ranged from 0.03 to 0.55 and 0.10 to 0.54 of the two sections. The reliability coefficients of Cronbach α for two sections were 0.82 and 0.84. The criterion validity was 0.59 between the sample's scores of "Oral Express Ability Test for Children". The test equating technique was applied and the software PARSCALE 4.1 was used to estimate the parameters. The means of parameter estimates were as follows: 0.45 for discrimination (ranged from 0.00 to 1.26), 0.03 for difficulty (ranged from -6.43 to 3.40). The instrument provided proper information to assess students with the ability levels that were within 1 SD unit above the mean.

5E – 2 (225) Meta-analysis of effects of inquiry teaching on student learning

Authors: WANG Jing-Ru, HUANG Bao-Yuan, TSAY Reuy-Fen, LEE Kuo-Ping, LIN Sheau-Wen, KAO Huey-Lien, Taiwan

Science is ground in the process of inquiry. Therefore, the approach to teaching science should reflect this fundamental characteristic. The first aim of this study was to investigate the effects of inquiry teaching on elementary and middle school student learning outcomes as a whole body from the year 1997 to 2009 in Taiwan. The second aim of this study was to compare the effects of inquiry teaching on student learning outcomes in terms of conceptual gains, process skills attainment, and attitude toward science attainment.

A broad search resulted in the collection of 142 studies obtained from journal articles, conference papers, dissertations, and unpublished papers in Taiwan. The studies were analyzed using Hedges and Olkin's (1985) procedures of meta-analysis. The weighted combined effect sizes, d+, were tested for statistical significance by calculating the 95% confidence interval. The equality of the individual effect sizes from each study is measured with the homogeneity Q test statistic. If Q was significant, the outliner was removed until a non-significant Q value, $p>0.05$ is obtained. To increase the reliability of measurement of the features of the studies, the values in each study were obtained after the scoring between two independent researchers with the help of the other researchers. The results were described in two parts as following.

First, regarding the overall learning outcomes, two hundred and seventy two effect sizes were computed from 142 relevant studies. The untrimmed overall mean effect size estimate was 0.46 and the trimmed overall mean effect size estimate was 0.45. Trimming did not affect overall estimate in any meaning way 70 effect size estimates were removed.

Second, concerning the three types of learning outcome (mastery of science content, process skills gain and attitude toward science attainment), two of the trimmed overall mean effect size estimates were similar to the untrimmed overall mean effect size estimates, science

content knowledge (untrimmed/trimmed: 0.46/0.45) and attitude toward science (untrimmed/trimmed: 0.33/0.33). Only one of the trimmed overall mean effect size estimate was smaller than the untrimmed overall mean effect size estimates, science process skills (untrimmed/trimmed: 0.59/0.40). In addition, all of these effect sizes would be judged to be significant (QB=10.63***, $p<0.01$). The 95% confidence intervals for the effect size of learning outcome categories clearly showed that inquiry teaching was more effective in raising student conceptual knowledge than attitude toward science. The confidence intervals for the process skills contained overlapping ranges with content knowledge and attitude and would therefore be judged not to differ from other learning outcomes.

The evidence presented in this study justifies the continued use of the inquiry teaching in the teaching of science.

5E - 3 (240) Toward establishment of a "fair" assessment system: An analysis of alignment between standardized exams and the national curriculum standards

Authors: LIANG Ling, CHEN Xian,
MA Hong Jia, FULMER Gavin,
United States

Test content validity is one of the most critical issues in the establishment of a fair assessment system. This study tackled this issue by examining the alignment between the Chinese national science curriculum standards (physics, chemistry, and integrated science, grades 7-9) and the corresponding city-wide standardized exit exams at the 9th grade level. Both curriculum content standards and test content were represented using two-dimensional matrices (i.e., by topic and by level of cognitive demands) and Porter's alignment indices were reported. It was found that there was no statistically significant alignment between the curriculum standards and each corresponding exit exam, as all three exams consistently over-represented the curriculum content standards at higher cognitive levels. The study also indicated that there was a mismatch between the content distribution of the test items and what is emphasized in the curriculum standards. Given the exam-driven nature of the Chinese education system, especially at middle school and high school levels, such nature of the high-stakes exams may influence the classroom instruction and curriculum implementation in both positive and negative ways. To ensure the implementation of the new curriculum standards, the authors suggested that ongoing alignment studies be conducted as a way to monitor the quality of high-stakes assessments and improve the fairness of assessment systems. The authors also provided recommendations for future alignment studies examining three critical aspects of instruction and evaluation: the curriculum content standards, classroom instruction, and standardized tests. Such alignment research may provide science educators, teachers, and educational policymakers with valuable information to reflect upon the practices in classrooms and schools, as well as on the further improvement of the science curriculum standards, which ultimately impact the success of the standards-based science education reform.

Symposium 3 - ICT in Science Education (科學教育與科技)

Date: 21 December 2010 (Tuesday)
Time: 15:00 – 16:00
Room 6: D1-LP-08

專題研討會 3: 電子學習 2.0：常識科的學與教 (313)

作者: 蘇詠梅, 詹文通, 羅玉婷, 趙崇基, 林蘭芳, 香港

隨配合香港資訊科技教育的發展，教育局已於 2007 年之第三個資訊科技教育策略及 2009 年之課本及電子學習資源發展專責小組報告中提出以電子學習配合 Web2.0 應用技術的新學習環境來促進多元化學習模式，使教學的互動更普遍及快捷；當中主要有兩方面內容，包括透過互聯網進行協作和分享及在教學上應用流動科技進行隨時隨地學習。

在應用透過互聯網進行協作和分享方面，可應用不同的互聯網平臺進行，如社交網站、即時通訊系統及網上分享網站等等，這樣學生能把研習檔案放在個人網誌中，不但可把學習過記錄及成果分享，而可以隨時隨地與同學討論研習問題，發揮創協學習的精神，有助進行協作學習及分享知識，達至互動，以發展學生的探究學習技巧。

在應用流動科技作教學應用方面，亦可應用課室回應系統(iTALC)、配備標準軟件的流動裝置、無線網絡裝置、電子白板及快速回應碼裝置等等工具，提升師生在課堂內的互動空間，提高以便隨時隨地學習。

但是，如何有效運用 Web 2.0 應用技術在電子學習呢？本專題研討會透過使用本地教師利用在 Web 2.0 應用技術於常識科的探究學習設計為主題。讓學生學習如何利用 Google 地球及檔、網誌、Do Do Code (QR Code) 快速回應碼、Ubuntu、osTube、Facebook 及 WebQuest 等網上工具來進行探究學習。有關研究以十多個不同形式的課堂設計，在本地約五間不同的小學進行相關常識科的實踐教學，蒐集應用案例及教學法，如合作學習、網路探究及探究學習等等的元素，使 Web 2.0 應用技術及資訊科技教育能有效融入教學及學習層面，鼓勵常識科及其他學科教師使用不同形式的學與教材料，加以實踐和配合應用，迎接電子學習 2.0 的教學新趨勢。

Parallel Session 6A - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)

Date: 21 December 2010 (Tuesday)
Time: 16:00 - 17:00
Room 1: D2-LP-08

6A - 1 (211) 職前教師設計與評論動態表徵融入科學課程之研究

作者: 黃昭仁, 張欣怡, 台灣

教育科技的進步日新月異，網路上各種教育資源豐沛，例如：網路上的 3-D 動畫、動態模型或虛擬實驗。設計良好的動態表徵可以呈現抽象或複雜的科學現象與概念，對於學生學習動態的過程亦特別有幫助（Chang, Quintana & Krajcik, 2010）。然而網路上可獲得的教學資源品質良莠不齊，資深教師或能以自身經驗，篩選適合的資源來豐富教學內容，但缺乏教學經驗的職前教師該如何判斷、運用這些網路教學資源，是職前教師專業成長課程所應重視的重要課題。本研究設計並實施一個職前教師的專業成長課程，課程內容以發展職前教師設計與評論動態表徵融入科學課程之能力為主軸。本研究目的即為探討參與該課程之職前教師，其設計與評論動態表徵融入科學課程能力的發展與改變。

參與本研究之職前教師為台灣南部地區修習該教育學程課程兩個班級共 72 位大學四年級學生。收集之資料包括職前教師於課程前、中、後，對動態表徵科學課程的評論，以及課程中所設計之動態表徵科學課程。本研究嘗試以知識整合觀點（Linn, 2006）分析這 72 位職前教師的評論與設計能力。知識整合觀點強調科學概念的深度理解與學習，以知識整合觀點探討職前教師對於動態表徵科學課程的評論與設計，有助於研究者瞭解職前教師是否俱備「利用動態表徵進行教學以促進高層次科學學習」之專業知識。

6A - 2 (287) 新疆維吾爾自治區職前理科教師“科學探究知識”調查研究

作者: 李玉峰, 中國

教師的科學探究知識是理科教師專業知識的重要組成部分，職前教師通過教法課的學習是獲得科學探究知識的主要途徑。本研究旨在了解職前教師具有的科學探究知識是否適應基礎課程改革的需要，對理科教師教法課的開展提出建議。在本調查中從科學探究過程的理解、科學探究的外顯行為、科學探究的教學方法、科學探究的評價方式知識等四個方面，對新疆維吾爾自治區主要師範院校的四年級的理科師範生進行調查。期望通過本研究對理科教學法的內容設置提出一定的建議，使之更加適應基礎教育改革的需要。

Parallel Session 6B - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)

Date: 21 December 2010 (Tuesday)
Time: 16:00 - 17:00
Room 2: D2-LP-09

6B – 1 (249) Development of pedagogical content knowledge for teaching nature of science: A case study of prospective biology teachers

Author: LO Man Sum, Hong Kong

Developing students' Nature of Science (NOS) conceptions is recognized as a science curricular emphasis in the recent education reforms around the world. Preparing teachers to teach NOS is becoming increasingly important in order to meet the shortage of apt teachers in teaching NOS. Studies showed that teachers require more than knowledge of NOS to be successful. It is suspected other knowledge bases for teaching is important in informing teachers' pedagogical decision related to NOS instruction. Among them, pedagogical Content Knowledge (PCK) is most germane to teaching practice hence the development of teachers' PCK is a coveting goal for educators. However, virtually no study focused on the development of PCK for teaching NOS (PCKnos). This study aimed to fill this research gap through studying how preservice teachers acquire PCKnos in a teacher preparation program in a university in Hong Kong.

Ten preservice teachers majoring in biology teaching has participated in the study. In the Major Methods Course of the program, preservice teachers were required to complete three assignments that focused on infusing NOS ideas in teaching biology. All assignments placed emphasis in the reflection, and two assignments used video technology to support preservice teachers' development. This study adopts a qualitative case study methodology by content analysis of assignments and intensive follow-up interviews to study PCKnos encapsulated in the assignments. We explored the emergent themes of 1) the content and development of PCK for teaching NOS during the course of the program, and 2) the influencers of PCK development in the context of the teacher preparation program. It was found that the development of PCKnos is idiosyncratic while teaching experience seems to be an essential ingredient in spurring reflection and consolidation of PCKnos.

6B – 2 (353) The preservice science teacher education program in new science curriculum of Mainland China: From the pedagogical perspective

Authors: HUANG Dao Ming, XIAO Hua, China

Large numbers of qualified teachers are needed urgently under the background of New Curriculum Reform in Mainland China. Although nearly fifty universities have set up science education major to cultivate prospective science teacher, former research found these preservice teachers' teaching abilities, especially pedagogical content knowledge are limited. The major reason lies in the lack of effective model for science teacher education. It's necessary to probe what these student teachers need and build up corresponding pedagogical program.

In this study we investigate preservice science teachers (N=43) of two normal university in South China. By using the questionnaire and interview protocols which developed from the Teacher Education and Learning to Teach study project (NCRTE, USA, 1995), we focus on four aspects: The teaching and learning of science; Influence of pedagogical program; Teaching and learning in general and Teaching as career. Results show that the student teachers need to improve their abilities in scientific inquiry, collaborative learning and teaching reflection.

Based on these findings and Conceptual Change theory, we design a Case-based experimental learning program which integrated above three factors to facilitate preservice science teacher improve their pedagogical ability to fulfill the requirement of new science curriculum.

6B - 3 (333) Mentoring for masters students as prospective science teachers: A case study in Mainland China

Author: DING Bang Ping, China

The aim of the case study is to identify both the merits and problems of mentoring for masters students as prospective science teachers in a newly-established two-year teacher education program in a normal university in Beijing. A class or 32 masters students in science teaching and their school-based mentors, also 32 in number for each of the students, in secondary schools are participants in the study. Research techniques f questionnaires and in-depth interviewing are used, with the former covering all the 32 dyads of participants, and the latter concentrating on 6 dyads of them. The findings of the study are to be analyzed at the moment. It is tentatively found that most of the prospective science teachers in the study claim that they have learned much more professionally from their school-based mentors than from the university coursework; however, some of the coursework is more relevant than others. As for the mentor-participants, the new experience of being involved in mentoring masters students in science teaching have made them more conscientiously aware of their PCK in teaching, which is found rich in the school settings but poor in the provision of university courses. For both school-based mentor-participants and prospective teacher-participants, the new program is considered relevant, necessary, and significant, but some problems arising from it also stand out, awaiting further improvements in its design and implementation.

Parallel Session 6C - Learning and Teaching Science (科學教學策略)

Date: 21 December 2010 (Tuesday)
Time: 16:00 – 17:00
Room 3: D2-LP-10

6C – 1 (290) 結合繪本與「動手做」遊戲教學法對學齡前幼兒科學學習的影響

作者: 周珮涵, 劉嘉茹, 台灣

本研究旨在發展一個結合繪本與「動手做」遊戲的幼兒科學教育課程，並評估此教學法對於幼兒科學能力的影響。研究對象為高雄市某幼稚園 30 名學齡前幼童(平均年齡為 6 歲)，研究工具為自行開發的 4 套結合「動手做」遊戲的繪本教材，平均每套教材的課程時數為 60 分鐘。研究方法採單一組樣本前後測實驗設計，資料的蒐集方式包括錄影、觀察以及半結構式晤談。參與研究的幼童在課程前後皆須接受半結構式晤談，以瞭解課程前後的差異。晤談問卷為研究者參照盧美貴（2003）所發展的「五歲幼兒科學領域學力指標」來設計的幼兒科學能力開放式問卷，內容包括科學態度、科學技能與科學現象三大主軸與各項學力指標。研究 結果發現，透過結合繪本與「動手做」遊戲的教學課程能增進幼兒的科學體會，在科學態度與科學技能的各項指標中亦有所進步，但在科學現象指標上則尚未發現明顯效果。因此，結合繪本與「動手做」遊戲的科學課程設計，在繪本故事中融入科學情境，再透過「動手做」玩科學的方式增加科學體會，能夠建立幼兒快樂的科學學習經驗，而促進科學能力的發展。

6C – 2 (267) 統整科學與語文敘事課程教學設計與分析

作者: 黃孝宗, 黃台珠, 台灣

本研究旨在探討國小教師指導二十四位六年級學童進行統整科學與語文敘事課程模式之發展。研究目的包括探討統整國小科學與語文課程的理論取向再概念化；應用課程地圖、故事地圖於選擇以及組織課程的適用性；並探討課程與教學設計的檢核機制。行動研究之歷程首先以學校文化的再生與權力的再建構視角探討統整課程的再概念化；其次以課程地圖指導課程全貌的發展；接著為求貼近學童的學習經驗，運用故事地圖發

展統整科學與語文敘事活動教學設計，並據以進行實際教學。研究結果的呈現採用質性資料分析，以校本課程閱讀書目的重新編定與類別屬性的連結、驗證課程地圖發展統整課程的成效；以教學目標分類檢核統整科學與語文敘事活動教學設計，並以認知領域教學目標檢核學習成果。結果顯示：學科知識的核心概念、主要概念以及概念階層之外，適合統整的關鍵問題與材料是決定統整成功與否的重要因素；以故事地圖進行敘事活動有助於學生整合科學與語文學習，而敘事內容長度與品質均受到學童學習與生活經驗豐富與否的影響；對於教學者的教學設計、學習者學習成果，以歷程檔案及深度訪談資料進行檢核後分成心得與反思兩類彙整。最後對統整科學與語文敘事課程模式之實施提出具體建議。

6C – 3 (352) 《科學技術概論》課程資源的開發與利用

作者: 卞祖武,中國

《科學技術概論》是中國大陸對文科大學生進行科學教育的通識課程。該課程把科學發展史、科學方法論、基礎科學、應用科學、高新技術以及它們與社會的相互作用結合起來進行教學，是一門綜合性、高效率的課程，通過學習可以提高文科大學生的科學文化素養。但自 1980 年代中期以來，該課程教學始終存在著內容多課時緊、綜合師資欠缺、學生積極性差以及課程資源匱乏等問題，我們的研究旨在解決這些問題，以提高教學效率。我們選擇課程資源的開發與利用為突破口，應用學科教學論、教育技術學的思想、觀點、方法，從文本教材資源、電子課件資源、科技資訊資源、教學圖片資源、數位音像資源和科技活動資源等六個方面，對課程資源實施了立體開發和綜合利用。2004 年以來，我們編寫出版了適應校情、學情的《科學技術概論》教材，組建了多個學生社團開展豐富多彩的科技社會實踐活動，開發了科技資訊、教學圖片、數位音像和科技活動資源庫，構建了教學效果優、教育效益佳、社會效益好的課程資源開發與利用模式，應用於課程教學實踐取得了良好效果。這一研究已獲本校 2010 年教學成果獎，正在申報省級教學成果獎。

Parallel Session 6D - Learning and Teaching Science (科學教學策略)
Date: 21 December 2010 (Tuesday)
Time: 16:00 – 17:00
Room 4: D1-LP-06

6D – 1 (125) 淺談新課程改革下教師使用教材的誤區及創造性使用教材的建議

作者: 高勛, 中國

2001 年，全國開始實行課程改革，首先進行的是義務教育的課程改革，至 2008 年，全國的初中已經全部進入實驗。高中階段則是從 2004 年秋開始逐步進入實驗，至今已有寧夏、上海、廣東、山東、江蘇等省成為實驗區。原來傳統的教學中認為教材的價值在於"規範"教學，將教科書等同於教材，而教材即知識，並是唯一的課程資源。隨著課程改革，教師的角色與理念不斷在轉變，他們認為教科書只是具有代表性的核心教材，而教材只是提供了引導學生認知發展、生活學習、人格建構的一種範例。教師不能是教教材，而是要用教材教。隨著課程改革的逐步深入，教師對新教材的認識也越來越深，他們積極主動地選擇和增添教學資源，創造性地使用教材。但是由於一些客觀的原因以及升學壓力的影響，部分教師對教材的使用也存在誤區。本文闡述了在江蘇省各地區的學校聽課時，所發現的一些教師使用教材過程中的誤區，例如將教材狹義化，完全用學案代替教材，隨意解構教材等。並針對現在教學中教師使用教材的誤區，對如何創造性地使用教材提出了幾點建議，以期對一線教師如何更好地使用教材，在培養學生的生物科學素養、創新精神和能力等方面起到幫助。

6D – 2 (133) 類比學習環對八年級學生浮力概念改變之影響

作者: 林建隆, 徐順益, 台灣

本研究旨在以類比學習環發展國中浮力單元教學模組，以克服學生迷思概念。經由探討八年級學生有哪些浮力迷思概念，並據以設計類比學習環融入浮力單元教學模組實施教學，比較實驗組與控制組學生於教學後對浮力迷思概念的改變情形。並針對類比學習環的確認、檢索、映射、評估四個步驟，進行教室觀察、晤談等質性資料收集與分析，探討產生概念改變的機制。

浮力迷思概念診斷試題設計過程，先透過開放式問題設計，選擇已學過與未學過浮力單元國中生各一個班進行預試，分析學生浮力迷思概念。並據以發展成為二段式浮力迷思概念診斷封閉試題。研究樣本為台灣中區某城市國中八年級未學過浮力單元的常態編班學生，實驗組與控制組各一班。實驗組採研究者發展的類比學習環教學模組教學，控制組則以一般教科書採講述式演示教學，兩班皆由原班理化資深教師進行教學，並於教學前與實驗班教師進行類比教學模組設計理念研討。於教學前對實驗組和控制組分別做浮力迷思概念診斷試題的前測，教學後再進行迷思概念診斷後測。研究資料的搜集包含學生的上課工作單、教室觀察紀錄、教學活動攝影紀錄及前、後測，資料分析則針對實驗組與控制組的前、後測平均進步分數進行 t 檢定考驗，比較兩組學生的浮力迷思概念改變，是否達顯著差異水準？並針對實驗組所蒐集的質性資料和學生討論過程錄影進行轉錄與原案分析，獲得以下結論：

一. 國中學生的浮力迷思概念，有下列類三種類型：

（一）有關沉浮因素方面的迷思
（二）有關是否受浮力的迷思
（三）有關影響浮力大小方面的迷思

二. 以兩組的前、後測成績差，即迷思概念的改變情形，作 t 檢定考驗，以類比學習環融入浮力單元教學模組教學的實驗組，克服浮力迷思概念的成效顯著優於以一般教科書教材實施教學之控制組。

三. 將類比學習環的確認、檢索、映射、評估四步驟融入浮力單元實施教學，確實能有效幫助學生克服迷思概念，尤其在映射步驟更是產生概念改變的主要階段。

Parallel Session 6E - Teacher Education/Professional Development for Teachers (科學教師培訓與教師專業發展)

Date: 21 December 2010 (Tuesday)
Time: 16:00 – 17:00
Room 5: D1-LP-07

6E – 1 (347) Identifying souses of stress among high school chemistry teachers at Shaanxi province in China

Authors: ZHOU Qing, LIU Ya Zhuan, ZENG Yu Gui, China

Objective: The study attempts to identify the major souses of stress among high school chemistry teachers in Shaanxi province in China in the background of new curriculum at present. Methods: We surveyed 101 chemistry teachers (52 males and 49 females) from 15 high schools in Shaanxi province in China with a self-administered questionnair at a return rate of 72.14%. Results: The results shows the occupational stress among these teachers is prevalent and relatively heavy. Among the 19-item souses of stress , investigated through factor analysis, resulted in five distinct dimensions of perceived stress: teaching workload(34% common variance), school system(11% common variance), society treatment and demands(7% common variance) and self-development demands(6% common variance); school hardware facilities(5% common variance); The top three sources of stress were, in descending order of mean scores: 'social treatment and demands, ' parents demands', and 'self-development demands'. Conclusion: The top three souses of stress perceived by the Shannxi chemistry teachers that is directly related to the relatively income but high demands of teachers in China, Which is largely resulted in less the education investment. There is a need for the inclusion of stress management programs for both trainees and in-service teachers. Measures such as increasing teachers wage, improving schools' humanistic environment and school hardware facilities, creating more opportunity for the development of teachers should be given to mitigate stress of high school chemistry teachers at Shaanxi province in China, so teachers can live and development healthily.

6E – 2 (132) The study of how science teachers promote professional knowledge in instructing primary science fair

Authors: LU Chow-Chin, CHEN Chung-Yu, Taiwan

The purpose of this study is to probe how "case-method teaching" assists a university professor to implement their curriculums and to guide science teachers, the case-method teaching's reliability and validity is built by CIPP Evaluation Model and Kappa analyze (Lu, C. C., Chiang, L. C., & Hsiung, C. T. ,2009). In particular, in instructing the production of elementary-school science exhibitions. To demonstrate the actual scenarios of the latter, the researcher has collected films taken by experienced teachers in instructing students for science fairs. In addition, the researcher explores how science teachers promote their professional knowledge.

First of all, by "participant observation", the researcher observe the instructional events and record the through process by films. The main purpose is to kept a record of two things: (1) the ways that university professor combine case-method teaching with her curriculum; (2) the specific demonstrations that help the science teachers emulate their goals. Then, compared with work- sheets which science teachers made at class, the researcher analyze all data by grounded theory. After repeated contrast and verification, the researcher deduces the conclusion.

The results of the research reveal that case-method teaching combined with worksheets helps science teachers make records, engage themselves in self-reflection, and discuss with each other. Other than these, they come to have a better idea of those scientific projects on science exhibition and are even able to develop their own theories. Generally speaking, these science teachers agree that: (1) case-method teaching helps them understand the contents of the curriculums; (2) it provides them models to observe and imitate.(3) the research concludes that science teachers should relate their own experiences to scientific theories and case-method teaching. With such an increase of awareness, knowledge transference is brought out. Thus professional knowledge would be promoted.

6E – 3 (105) The influence of Marxism on Chinese science teacher educators' conceptions of nature of science to be taught to prospective science teachers

Authors: WAN Zhi Hong, WONG Siu Ling,
Hong Kong

Teaching nature of science (NOS) is beginning to find its place in the science education in China. An exploratory study was conducted to investigate Chinese teacher educators' conceptions of teaching NOS to prospective science teachers. Twenty-four educators took part in two semi-structured interviews. Five dimensions emerged on the conception of teaching NOS. This paper focuses on reporting the findings of a key dimension, NOS content to be taught. Among the NOS elements identified, four are not commonly included in the Western literature on NOS education. They are (i) science as the pursuit of truth, (ii) truth-approaching nature of scientific knowledge, (iii) realism views of mind and natural world, and (iv) three key laws of dialectical materialism. There are five NOS elements which were suggested by more than a half of the educators in this study as NOS content to be taught, which consists of (i) empirical basis of scientific investigation, (ii) logics in scientific investigation, (iii) progressive nature of scientific knowledge, (iv) realism views of mind and natural world, and (v) general process of scientific investigation. In the end, on the basis of these findings, the paper further discusses the influence of Marxism, a special social-cultural factor in China, on Chinese science teacher educators' conceptions of NOS content to be taught to prospective science teachers.

Symposium 4 - Learning and Thinking Electrical Power

Date: 21 December 2010 (Tuesday)
Time: 16:00 – 17:00
Room 6: D1-LP-08

4-1 (260) Facilitating learning and thinking electrical power through a divergent task

Authors: YAP Kueh Chin, CHIA Kok Pin, TAN Peck Har, Singapore

Designing a task that could be used for various educational purposes such as instruction, assessment, science teacher education and research purposes is a worthwhile effort in science education. This paper presentation will discuss how a divergent task has been designed based on an adaptation of an original convergent task in the Science Curriculum Improvement Study (SCIS) on models in science (Berger & Karplus, 1968). The original convergent SCIS task involves the arrangement of six bulbs which when connected to an electrical source will have different brightness. The divergent task requires learners to sketch as many mixed circuits as possible so that the conditions for the different bulb brightness are maintained. Based on the conditions of the bulb brightness given, six possible combinations of circuit connection were identified. Such a task was then used for instruction, assessment, science teacher education and research purposes. This presentation will also focus on how such a divergent task will inculcate various thinking skills like spatial thinking, combinatorial thinking, pattern seeking, logical thinking, and inverse and direct proportionality. Based on this task, students will learn to sketch mixed series and parallel circuits and connect brightness of bulb to electrical power. More importantly, through this divergent task, students learn not just to memorize the three electrical power relationships but to know when to apply the appropriate relationship.

4-2 (261) A quantitative study of students' understanding of electrical power

Authors: CHIA Kok Pin, TAN Peck Har, YAP Kueh Chin, Singapore

This quantitative study will investigate upper secondary students' understanding of spatial concepts through drawing of direct current electrical circuits. With a given context, they are challenged to think and to design as many electrical circuits as possible with light bulbs of different brightness. From the various electrical circuit designs, students' divergent thinking can be quantified and investigated. In grooming future generations of thinking citizens, it is deemed to be of paramount importance that students are provided with opportunities to develop their thinking skills in school. Through designing direct current electrical circuits, this study hopes to gain a better insight into students' thinking abilities when they are confronted with a situation that requires them to explore various perspectives and to make meaningful connections between electrical concepts. The results of this study shows evidence of divergent thinking and spatial thinking which reinforces the importance of contextual thinking and how it can be a stimulus for more meaningful learning of some electrical concepts that are often taken for granted that they have been learnt well.

4-3 (262) A qualitative study of students' alternative conceptions on electrical power

Authors: TAN Peck Har, YAP Kueh Chin, CHIA Kok Pin, Singapore

This paper aims to study students' alternative concepts on electrical power through qualitative methodology. Using an open-ended six-bulb mystery diagnostic task, the students are tasked to design as many circuit connections of specified desired brightness as possible and also, to provide an explanation based on their knowledge of relevant Physics principles/ ideas as to why these connections are possible. Through their explanations, it is possible to determine students' thinking and understanding of various Physics concepts involved in the functioning of direct current electrical circuits. For the purpose of this study, these explanations will be categorized into (i) correct circuits with correct explanation (ii) correct circuits but with incorrect explanation and lastly (iii) incorrect circuits and their corresponding explanation. From the findings of this qualitative study, Physics educators can gain a better insight into students' conceptual understanding on the topic of electrical power. More importantly, it serves as a platform for Physics educators to explore effective teaching strategies and develop materials for students to help them gain a better conceptual understanding on the topic of direct current electrical power.

List of Workshops 工作坊

Workshop	*Organization/ Presenters*	*Title*	*Time & Venue*
#Workshop 1	鄺偉良先生、黃志堅先生、張錦華先生 (香港數理教育學會)	香港理科教師在新高中課程遇到的挑戰與機遇	December 20 11:15 – 12:00 Room 8: D2-LP-12
Workshop 2	陳勇輝博士, 楊玉枝女士 (台灣國立海洋生物博物館)	教育功能與角色	December 20 11:15 – 12:00 Room 4: D1-LP-06
Workshop 3	Dr. SHEN Ji, Dr. CHANG Hsin-Yi	(103) Designing effective embedded assessments in technology-enhanced science curricula	December 20 11:15 – 12:00 Room 9: D4-LP-02
Workshop 4	Mr. Byron LI Wah Hong (WWF – Hong Kong) (世界自然基金會香港分會)	How to use innovation e-learning and mobile learning technologies for conducting environmental education programmes at remarkable ecological hot spots in Hong Kong	December 20 13:15 – 14:00 Room 4: D1-LP-06
#Workshop 5	鄭慕賢博士	(274) 如何成為一名有創意的教師	December 20 13:15 – 14:45 Room 8: D2-LP-12
Workshop 6	Mr. PAU Chiu-Wah, Mr. MAK Hon-Lung (Hong Kong Examinations and Assessment Authority) (香港考試及評核局)	Assessment of science subjects in public examinations in Hong Kong: Entering a New Era in 2012	December 20 14:00 – 14:45 Room 3: D2-LP-10
Workshop 7	GreenPeace (綠色和平)	Applying science in environment protection to achieve positive changes in equity	December 20 14:00 – 14:45 Room 4: D1-LP-06
Workshop 8	Eco-Education & Resources Centre	Escape from classroom - Outdoor education programmes	December 20 14:00 – 14:45 Room 5: D1-LP-07
Workshop 9	Association for Geoconservation, Hong Kong (香港地貌岩石保育協會)	Roles of NGO in popularizing geosciences	December 21 10:00 – 10:45 Room 3: D2-LP-10
Workshop 10	Mr. WONG Shek Nin (Aberdeen Technical School)	Promoting students' scientific attitude through informal contexts: From local to national	December 21 10:00 – 10:45 Room 4: D1-LP-06
Workshop 11	Mr. LAU Sai Chong (Lingnan Dr. Chung Wing Kwong Memorial Secondary School)	Innovative technology creates a new world record	December 21 13:15 – 14:00 Room 3: D2-LP-10
Workshop 12	Prof. Benny YUNG Hin Wai, YIP Wing Yan Valerie, LAI Ching	(331) Making use of students' prior ideas to teach nature of science	December 21 13:15 – 14:45 Room 4: D1-LP-06
Workshop 13	Dr. Jimmy WONG Kam Yiu (Hong Kong New Generation Cultural Association Science Innovation Centre)	In search of innovative talents	December 21 14:00 – 14:45 Room 5: D1-LP-07

#Total number of participants is limited to 30-35. Seat allocation will be made on a first-come-first-served basis.
(參加人數名額為 30-35 人。席位名額是以先到先得方式分配。)

Content of Workshops 工作坊內容

工作坊 1: 香港理科教師在新高中課程遇到的挑戰與機遇

發表者/機構：鄺偉良先生、黃志堅先生、張錦華先生 (香港數理教育學會)

20 December 2010 (Monday), 11:15-12:00, Room 8 (D2-LP-12)

香港自 2009 年 9 月開始，中學從 3+2+2 學制(三年初中、兩年高中和兩年預料)轉變成為 3+3 學制(三年初中和三年高中)。為配合新學制的推行，高中課程作出了相應的改革，科學教育領域的課程除了保留傳統學科(包括物理、化學、生物)外，亦加入綜合科學科，供學生選修。這次改革不單是結構上轉變，亦是教學文化的轉變。轉變過程中，香港理科教師面對不少新挑戰，香港數理教育學會在 2010 年 4 月至 7 月期間，向任教新高中理科和數學科教師進行調查，瞭解他們在新學制推行初始階段所遇到的挑戰，以及探討科學教育在新高中課程情境下的發展。調查分兩個階段，第一階段通過電郵和焦點小組訪談，以開放式問題調查會員在新高中教學遇到的困難，然後把這些難題歸類。第二階段問卷調查，就前階段發現的問題範疇設計問題，然後同時以郵寄和網頁發放給教師。以全港十八區進行分層隨機抽樣（Stratified Random Sampling），向 180 間中學發出問卷，共收到 68 間學校寄回問卷，回收率為 38.6%。這裡就教師關注的範疇，包括學生學習差異、學科間的協作、校本評核等，匯報調查結果及討論。

工作坊 2: 水族型態之科學博物館 - 教育功能與角色

發表者/機構：陳勇輝博士, 楊玉枝女士 (台灣國立海洋生物博物館)

20 December 2010 (Monday), 11:15-12:00, Room 4 (D1-LP-06)

位於台灣恆春半島的國立海洋生物博物館（以下簡稱海生館）為本國規模最大之水族型態之科學博物館，亦為推動海洋相關科教與通識教育之重要推手。海生館結合民間公司遊客服務之專長與公務部門企劃研發之教育本質，在完整的組織架構之下，截長補短、相輔相成，共同推動海洋生物生態保育工作迄今以達 10 年之久，前來海生館參觀之社會各階層民眾已超過上千萬人次，成為本國各級學校戶外教學或畢業旅行之首選場所。本館以海洋生物為內容，除了一般博物館的場次解說與現場導覽工作之外，尚開發各型各類的科教活動，為讓觀眾深入瞭解海洋生物相關科學知識，如與魚共眠（夜宿海生館）之科教活動乃以導覽方式導入以學習者為中心的探索體驗活動，內容包括後場探索水生生物活動 夜間尋訪珊瑚礁生態，以及與魚共眠瞭解夜間海洋生物生態等體驗活動，讓參與民眾都能透過深刻自身體驗瞭解海洋生物生態的科學知識與其意義。本文將以夜宿海生館科教活動 說明本館推動海洋科普教育的原則與策略。

Workshop 3: (103) Designing Effective Embedded Assessments in Technology-Enhanced Science Curricula

Presenters/Organization: Dr. SHEN Ji, Dr. CHANG Hsin-Yi

20 December 2010 (Monday), 11:15-12:00, Room 9 (D4-LP-02)

In this workshop, we aim to introduce the design principles and the features of embedded assessments in the Web-based Inquiry Science Environment (WISE) developed at the University of California, Berkeley (Linn, Clark, & Slotta, 2003). WISE is a powerful, free-access online learning environment that supports guided inquiry, embedded assessments, peer collaboration, interactive computer models, and teacher customization (Linn & Slotta, 2009). The WISE curricula are developed through partnerships of content experts, school teachers, educational researchers, and computer scientists and have gone through iterations of revisions. Research data have shown the modules are effective in helping students learn complex science concepts (Linn et al. 2006; Liu et al. 2008). As WISE curriculum developers and researchers (Chang, 2009; Liu et al. 2008; Shen, 2008), we will present the design principles that underlie the embedded assessments in WISE curricula. These assessments elicit students' repertoire of ideas on science (Linn, 2006), facilitate their knowledge integration processes (Linn & Eylon, 2006), and offer teachers opportunities to evaluate student understanding. Information extracted from student responses helps improve teachers' instructional practices and researchers' further design of WISE curricula. Sample items, scoring rubrics, and results on physical sciences (thermodynamics and electrostatics) will be explained. Participants will have hands-on experience in exploring various assessment steps in WISE, scoring sample student responses, create their own WISE assessment items, and discuss and share their ideas on developing technology-enhanced formative assessments with the audience and the presenters.

Workshop 4: How to use innovation e-learning and mobile learning technologies for conducting environmental education programmes at remarkable ecological hot spots in Hong Kong

Presenters/Organization: Mr. Byron LI Wah Hong (WWF – Hong Kong) (世界自然基金會香港分會)
Position: Senior Education Officer
Contact: 2652-3308 / bli@wwf.org.hk
20 December 2010 (Monday), 13:15 - 14:00, Room 4 (D1-LP-06)

Technology is key to attracting young people to understand and get involved in conservation issues, and WWF is mixing it all up by bringing conservation and mobile devices together at the Mai Po Nature Reserve to encourage educational awareness among primary school teachers and students.

WWF has implemented a six-month scheme, which providing training to 200 primary school teachers to help them organise their own environmental educational programmes for their school. The training included a three-hour training workshop as well as a six-hour field trip to the Mai Po Nature Reserve. The main focus of the training is using mobile technology in the nature reserve, from computers to digital devices and internet resources, to assist and inspire teachers and students to learn about environmental issues.

With the aid of well designed, readily accessible IT learning materials (both online and offline) and mobile learning devices, teachers have the opportunity to explore ecological, social and economic features of the wetland environment and learn about all the environmental education resources provided by WWF. In this way, the teachers on the course will be able to create engaging lessons focusing on environmental protection and sustainable development around Hong Kong that the Mai Po Nature Reserve helps promote.

The course also allows teachers to take part in outdoor observations, field experiments and data interpretation that use innovative tools such as digital microscopes, equipment for data collection, touch-screen handheld devices and video equipment, so that they can share this technology with students to enhance their experience at the reserve.

Increasing interactive activities such as using hand-held devices to calculate bird populations, carrying out experiments with portable digital microscopes, or using webcams to record experiences will bring students closer to the natural environment and further engage them in wildlife protection efforts.

While the first phase has finished, the teacher participants have implemented their student visit with the use of mobile technology to Mai Po Nature Reserve in this academic year. Another programme to secondary school teachers from the beginning of the new school year in September as well.

工作坊 5: (274) 如何成為一名有創意的教師

發表者/機構：鄭慕賢博士
20 December 2010 (Monday), 13:15-14:45, Room 8 (D2-LP-12)

面對眾多的教育改革和新措施，教師該如何提升自身的創造力來應對日新月異不斷變換的要求？本次工作坊將會提升參加者成為創意教師的願望及能力。首先，作為預熱活動，參加者將與同伴分享他們在教學中的創意及經歷。該活動旨在使參加者意識到"每個教師都是可以有創意的"，同時，增強參加者提升自身創造力的信心。然後，我們通過兩名教師的真實案例，探討教師如何能夠克服阻礙，成功探索未知的、創新的想法，敢於冒險，平衡課堂上的不同需求，最終在改革中經歷一個彈性的變化之旅。歡迎各位小學常識科、中學通識科、科學科及其它科目教師參加。

Workshop 6: Assessment of science subjects in public examinations in Hong Kong: Entering a New Era in 2012

Presenters/Organization: Mr. PAU Chiu-Wah, Mr. MAK Hon-Lung (Hong Kong Examinations and Assessment Authority (香港考試及評核局)

20 December 2010 (Monday), 14:00-14:45, Room 3 (D2-LP-10)

The science examination papers in the Hong Kong Certificate of Education Examination (HKCEE) and in the Hong Kong Advanced Level Examination (HKALE) have long been considered by local and overseas examination boards and educational bodies to be of very high standard and of important educational value. With the implementation of the New Senior Secondary (NSS) System in September 2009, the longstanding HKCEE and HKALE will come to a close for the school candidates in 2010 and 2012 respectively; and the new Hong Kong Diploma of Secondary Education (HKDSE) Examination will be on stage in 2012. One significant feature of HKDSE is the adoption of a standards-referenced approach in reporting the performance of candidates.

In this presentation, the speakers will introduce to the audience the public assessment of the science subjects in HKDSE, which include Physics, Chemistry, Biology and Science (Integrated and Combined), and the support offered by the Hong Kong Examinations and Assessment Authority (HKEAA) to science teachers, students as well as other stakeholders. We shall also discuss how standards are set and maintained in HKDSE, so as to provide a valid, reliable and equitable assessment of the achievement of students.

As Hong Kong is closely connected to other parts of the world, it is important for HKDSE to be accepted internationally. This presentation will also cover the effort and achievements of the HKEAA in securing international recognition of the HKDSE and in benchmarking HKDSE to other qualifications.

To help HKEAA better meet the challenge of the new era, interaction and feedback from audience are most welcomed.

Workshop 7: Applying science in environment protection to achieve positive changes in equity

Presenters/Organization: GreenPeace (世界自然基金會香港分會)

20 December 2010 (Monday), 14:00-14:45, Room 4 (D1-LP-06)

- Introduce Greenpeace and workshop rundown
- General water pollution situation in China
- What is hazardous chemicals & heavy metal, what is the effect to human body?
- Victim stories of water pollution
- The situation in our district and city
- What can we do?

Workshop 8: Escape from classroom – Outdoor education programmes

Presenters/Organization: Eco-Education & Resources Centre

20 December 2010 (Monday), 14:00-14:45, Room 5 (D1-LP-07)

Science education may sound boring for many students. Increasing the interest of students in science learning is a challenge for us. Instead of giving regular lectures in classroom; we tried to deliver our message through eco-tours and various outdoor activities like ecogames, DIY art work and experiments. Through all these activities, students not only can make connection between their daily life and different science topics to strengthen the message they learnt during the tour; they can also build up appreciate to the natural environment and wildlife through involvement. In this presentation, we will share how we arrange these activities and some successful examples.

Workshop 9: Roles of NGO in popularizing geosciences

Presenters/Organization: Association for Geoconservation, Hong Kong (香港地貌岩石保育協會)

21 December 2010 (Tuesday), 10:00-10:45, Room 9 (D2-LP-10)

Geosciences is one of the most difficult subjects to be promoted in Hong Kong and many other similar cities around the world. These cities do not rely on mineral nor energy exploration for their continual development. Geoscientific knowledge mainly serves geotechnical engineers in their infrastructure and housing developments whereas its major role as an important contributor to environmental education for its people being ignored. NGOs can play significant roles in promoting geosciences to the general public, schools, communities, private enterprises and other organizations with the purposes of popularizing geosciences, enhancing understanding, arousing interests, raising appreciation and awareness on environmental, particularly geological conservation. This paper begins by reviewing the roles of NGOs in promoting geosciences around the globe. It then cites Hong Kong as a regional example by listing the challenges that Hong Kong has been facing and the approaches and strategies to overcome the major hurdles which hinder popularizing geosciences.

Workshop 10: Promoting students' scientific attitude through informal contexts: From local to national

Presenters/Organization: Mr. WONG Shek Nin (Aberdeen Technical School)

21 December 2010 (Tuesday), 10:00-10:45, Room 4 (D1-LP-06)

Positive scientific attitude is a crucial factor attributing to the success of scientific research or investigation. The attitude should best be fostered from childhood and be internalized in individuals in the course of students' receiving science education at schools. However a number of studies reveal that students' passion for science drops with their gain of knowledge and experience. Questions therefore arise as to how science teaching can be conducive to developing students' scientific attitude. This workshop aims to offer successful experience on how to stimulate interests of students from different geographical area in science through hands-on project in an informal context, and how the project serves as a good starting point to inspire teachers, both locally and nationally, in innovative teaching of science in support of the development of positive scientific attitudes amongst students.

Nowadays, more and more primary and secondary schools in Hong Kong are rolling out hands-on scientific project or science investigative study with a view to developing students' scientific attitude and investigation skills. In this workshop, experience will be shared on how a school-based hands-on solar project could be developed into a cross-discipline school function that sparked off changes in students' attitude towards science and drew media and community's support. The workshop also offers positive experience in arousing interest of students, from local districts or the Mainland, towards science and in offering stimulus to science teachers from different geographical areas in adopting hands-on projects in science teaching.

The hands-on solar project was initially a science project developed by a local school for junior forms. It was later developed into a whole-school function which each student could participate. With efforts made to bid funding from different organizations, kits and self-learning CDs for this project was mass-produced for distribution to all primary and secondary schools in Hong Kong to promote hands-on science activity. After-school sessions were held for students from different schools in Hong Kong to participate in this science activity. To further propagate the momentum, experience was shared with teachers in the neighbouring city, Macau, and on the Mainland in Jinan and Sichuan at science education forums to promote hands-on projects and development of scientific attitude. Student experiential session was later extended to the national level, with students from Beichuan Middle School, Sichuan, participated in the hands-on project in an informal setting.

Results have been encouraging. Students welcomed the activity and their understanding and interests in science deepened. Teachers felt inspired by new ideas in developing students' scientific attitude through hands-on projects and appreciated how science education could be connected to the contemporary world.

To conclude, hands-on project in an informal context helps develop scientific attitude among students and the importance of this in science education is reaffirmed. To roll out the workshop, the one-hour session will be divided into two halves. The first session will focus on extending a local project to a national level and how it has successfully aroused students' interests and teachers' inspiration in science learning and teaching. The second-half hour is a "Do-it-yourself, DIY" session, in which each participant can experience personally a hands-on science activity.

I hope that the project could eventually go beyond Asia and be promoted in different corners of the world, nurturing positive scientific attitude among our youngsters.

Workshop 11: Innovative technology creates a new world record

Presenters/Organization: Mr. LAU Sai Chong (Lingnan Dr. Chung Wing Kwong Memorial Secondary School)

21 December 2010 (Tuesday), 13:15 – 14:00, Room 3 (D2-LP-10)

Our school has built a lot of local supports such as various tertiary institutions, professional bodies and organizations through organizing "The Hong Kong Technology Education Promotion Scheme" for 6 years. With full support from different parties, we aimed at making a breakthrough in the fair "Robots Relay Marathon" in 2006, targeted to setting a record in the Guinness World Records. In the technology education workshop, firstly I explained the lever principle and then guided the pupils to build the robots and illustrated the steps of setting a world record. After briefing, each participant and their parents worked together to make their own robot. Our school aimed at connecting over two hundred robots to walk together for one minute. At the first trial, the connection of robots was broken at the start because of different walking speed from each robot. After deliberation of the consultant groups, an improved start method was suggested. In the end, two hundred and fifty-five robots were successfully connected together and walked together for a minute. A new world record was set and our school successfully registered this new world record as a record in the Guinness World Records.

Workshop 12: (331) Making use of students' prior ideas to teach nature of science

Presenters/Organization: Prof. Benny YUNG Hin Wai, YIP Wing Yan Valerie, LAI Ching

21 December 2010 (Tuesday), 13:15 – 14:00, Room 4 (D1-LP-06)

In line with the international trend, recent development of science curricula in Hong Kong has seen a shift from the predominantly content-focused goal to a wider goal of promotion of scientific literacy in which understanding of nature of science (NOS) occupies a pivotal role. This poses a host of challenges in preparing teachers for teaching these new curricula. In particular, various studies consistently point to teachers' inadequate understanding of NOS and their lack of pedagogical skills in teaching NOS.

In responses to these challenges, a two-year teacher professional development program was set up to prepare teachers for teaching NOS. About 20 biology teachers formed themselves into three study groups, each facilitated by a science educator. The teachers worked collaboratively to help each other to learn how to teach NOS. To start with, the teachers were given curriculum resources for teaching NOS using an explicit and reflective approach. They adapted and refined the resources to cater for their own students; and then tried them out in their own lessons which were videotaped. The lesson videos were then shared and analyzed collaboratively in study group meetings to identify features of effective practices. Each group also identified video vignettes for further sharing with teachers in the other two study groups.

The video vignettes were then grouped and organized into seven themes for further discussion in subsequent thematic workshops. These include: (1) introducing students to NOS, (2) probing and making use of students' prior ideas in teaching NOS, (3) developing students' understanding of NOS, (4) consolidating students' understanding of NOS, (5) assessing students' understanding of NOS, (6) teaching NOS beyond the knowledge domain, and (7) critical incidents on teaching of NOS. To facilitate analysis and discussion of the videos under each of above themes, the teacher participants were guided by an analytic framework of effective NOS instruction. The framework comprises five dimensions, namely, (1) teachers' knowledge and understanding of NOS, (2) teachers' conceptions of their own role, (3) teachers' use of discourse, (4) teachers' conception of learning goals, and (5) the nature of classroom activities.

Teachers reported that organizing the videos in themes and reviewing them through an analytic lens have rendered the comparison of videos more meaningful. These have enabled them to discern the subtle differences in instructional practices that they might not have noticed otherwise.

In this workshop, we will re-run the activities on the theme Probing and Making Use of Students' Prior Ideas in Teaching NOS. Participants will have the opportunity to review video vignettes of exemplary NOS teaching, engage in productive discussion and meaningful comparisons of the videos using the analytic framework provided. Upon completion of the workshop activities, participants will be asked to reflect on and discuss the effectiveness of using videos to prepare teachers for reform-based teaching, like NOS teaching, where authentic classroom experiences are rare and difficult to locate at the beginning stages of the curriculum reform.

Workshop 13: In search of innovative talents

Presenters/Organization: Dr. Jimmy WONG Kam Yiu, Hong Kong New Generation Cultural Association Science Innovation Centre

21 December 2010 (Tuesday), 14:00 – 14:45, Room 5 (D1-LP-07)

The journey of searching, nurturing and supporting the scientifically gifted students is usually complex, challenging yet fulfilling. What has been the support behind in paving the way for a gifted student to be awarded and have a Star named after him/her? How do students face their achievement or failure? In what way does the HKNGCA Science Innovation Centre promote science and creativity education and to nurture innovative talents? The speaker will share his experience in identifying the scientifically gifted for taking part in science enhancement programmes and eventually selecting them for competitions at territory-wide up to international level, in providing opportunities for whole-person development of the gifted, and building connections between the professionals in the field and the students with advanced learning needs. Encouragingly, this journey of finding the scientifically gifted has started in more and more schools where learning and teaching strategies as well as school cultures are changing for the development of gifted education. Teachers demonstrate their commitment, and it continues flourishing in their professional development for the involvement of the whole school.

List of Poster Presentation 海報展覽

Poster Session 1
Date: 20 December 2010 (Monday)
Time: 12:15 – 13:15
Venue: Outside area of room D1-LP-02

Poster Session 2
Date: 21 December 2010 (Tuesday)
Time: 13:15 – 14:15
Venue: Outside area of room D1-LP-02

Board Number	*Title*	*Presenters*	*Reference Code*	*Poster Session*
1	ICE 促進/結合能源農村之環境教育的推廣與行銷	陳嘉彌, 朱士傑	92	Session 1
2	南台灣奈米教育推廣現況	林仁輝, 黃台珠, 陳元方, 林弘萍, 陳錫添, 張素瓊, 陳東煌, 馮榮豐, 蔡振章, 賴顯松, 陳訓祥, 陳芳怡	93	Session 2
3	論課程改革背景下的師範生科學素養教育	李偉	95	Session 1
4	Using asking questions to explore young children's views of sounds	CHIU Hsueh-Mei, KENG Hsiao-Tseng, LU Chow-Chin	97	Session 2
5	國小二年級學生動物園生物多樣性科學探究	賴慶三	106	Session 1
6	國小五年級專題本位天文教學之研究	賴慶三, 高玉娟	109	Session 2
7	How to create teaching cases under the POE teaching strategies from senior elementary mentor teachers	LU Chow-Chin WU Hua Shiuan	110	Session 1
8	浙江省在職初中科學教師 PCK 現狀調查與分析	任山章, 金建敏, 陳志偉	111	Session 2
9	The Longitudinal Investigation of a Collaborative Curriculum to Promote Taiwanese Underrepresented Secondary School Students' Self-development and Interests in Learning Science	HONG Zuway-R	112	Session 1
10	遺傳學學習困難之探究及其在教學上的啟示	朱幼倩	113	Session 2
11	Pre-service Teachers' Professional Growth of Big6 Skills-Information Technology Integrated into Elementary Science Instruction as an Example	LU Chow-Chin, TAI Wen-Hsiung	123	Session 1
12	提高生物實驗教學質量的有效方略	邵銀東	130	Session 2
13	後設認知策略對職前教師動機信念、學習策略及教學知識	林素華	131	Session 1
14	The Use of CD-ROM to Explore Second-Grade Students' Conceptions about Nanotechnology in Taiwan	CHIU Hsueh-Mei, LU Chow-Chin, SUNG Chia-Chi	148	Session 2
15	創造性問題解決融入科學遊戲的教學成效	許良榮, 張璠甄, 常蕙茹	154	Session 1
16	以事件相關電位分析法探討大學生對立體化學結構式的辨識差異	梁騏霖, 蔣秉穎, 黃琴扉, 劉嘉茹	159	Session 2
17	在數學探究教學下七年級學生數學素養展現之探討	秦爾聰, 陳家鵬, 尤昭奇	161	Session 1
18	綜合科學課程的認識問題與實施策略探討	王耀村	166	Session 2
19	對小學教師科學素質相關因素的調查研究	何麗	175	Session 1
20	蕨類生態園校本課程發展與實施成效之研究	王純姬	178	Session 2
21	學童的 H1N1 概念理解之研究	林宇涵 熊召弟	191	Session 1
22	探究進入科學教育館的學生科學學習動機及滿意度的表現	邱庭煒 熊召弟	193	Session 2

Board Number	Title	Presenters	Reference Code	Poster Session
23	動物園-生物多樣性昆蟲探索之研究	林容妃 賴慶三	197	Session 1
24	問題解決模式融入數位元元遊戲設計教學對於國小五年級學童學習問題解決能力之影響	何雅惠, 盧玉玲, 連啟瑞	200	Session 2
25	以「使用者為中心」設計自然與生活科技影片式輔助教材之實務研究	彭文萱, 熊召弟	206	Session 1
26	以眼球追蹤技術探討板塊概念圖形表徵理解歷程	侯依伶, 劉嘉茹	210	Session 2
27	以臆測為中心的探究教學對高中學生數學素養影響之研究	秦爾聰, 劉致演, 楊讚文	214	Session 1
28	A study on the conceptual understanding of chemistry freshmen in the topics of molecular geometry and polarity	TEH Yun Ling	244	Session 2
29	廣州市"科學小星星"專題探究活動的實踐與探索	馬學軍	246	Session 1
30	發展臺灣地區國高中奈米科技課程的專家概念	張慧珍	247	Session 2
31	國小五年級學生的對溶解的圖形表徵之初探研究	陳景期, 盧玉玲, 連啟瑞	252	Session 1
32	國小五年級結合社區資源中心實施環境教育教學探究	施春輝	255	Session 2
33	臺灣中學奈米科技課程建構之探究	于曉平, 李乙明	266	Session 1
34	創造力教學式之網路遊戲學習法對於學生科學創造性思考之初探	陳俊宏, 連啟瑞, 盧玉玲	282	Session 2
35	漢、英語科學新聞論述之分析比較	黃柏森, 楊文金	284	Session 1
36	2007-2009 年科學教育學刊內容分析	陳韋銘, 連啟瑞, 盧玉玲	288	Session 2
37	國小學生自然科學合作學習能力之初探	李欣樺, 連啟瑞, 盧玉玲	298	Session 1
38	Form Literacy to Content Language Integrated Learning: The PAOC Ka Chi Secondary School experience	CHOW Shui Ying, CHAU Wai Shing	311	Session 2
39	中學生力學概念轉變的心理機制研究	胡衛平	321	Session 1
40	PBL 對網路教育學生學習成績和班級感影響的實驗研究	鄧磊	324	Session 2
41	教科書中科學探究的教學目標設定工具的設計	馬冠中, 胡炳元	329	Session 1
42	臺灣國中小數學教科書之銜接性分析：以統計與機率主題為例	王馨梅, 吳心楷	335	Session 2
43	國中課後輔導班生生活化生命科學議題線上論點演變及論點來源之研究	辜千芳	342	Session 1
44	香港小學個案分析：應用網誌於記錄科學探究歷程之成效	羅玉婷	346	Session 2
45	面向學生生活世界的科學教育改革	劉德華, 蔡婷	351	Session 1
46	Studying the transients for understanding of some challenging topics in physics	FOONG See Kit	359	Session 1
47	"非常規"實驗設計理念在教學中的價值	林曉潔	360	Session 1
48	《中學物理課件設計與製作》課程建設與教學改革實踐	熊天信, 周曉林, 謝林華	363	Session 1
49	分科教師對推行綜合科學課程看法的調查研究	胡繼飛	364	Session 2
50	對科學素養的要素與結構分析	李亦菲	366	Session 1
51	全球化背景下教育研究範式轉變帶來的挑戰	張紅霞	368	Session 2
52	科學史科學社會學教育融入小學課程的研究	林海燕	370	Session 1

Poster Session 1 - Abstract 海報展覽 1 – 論文摘要

Poster Session 1
Date: 20 December 2010 (Monday)
Time: 12:15 – 13:15
Venue: Outside area of room D1-LP-02

(92) ICE 促進/結合能源農村之環境教育的推廣與行銷

作者: 陳嘉彌, 朱士傑, 台灣

本文是利用 PLAY 的概念，幫助學生從「行動(遊戲)」中體悟及學習減碳環境教育(Immune Carbone Education, ICE)知能的重要價值。PLAY 既具有「寓學於樂(Learning Through Play)」的涵義，也代表大自然是「豐富學習的育樂院(Profuse Learning Amusement Yard, PLAY)」的雙關語。此外，ICE 也是「個人(Individual)— 溝通/保護/消費 Communication/Conservation/Consumption)— 環境(Environment)」三個因素的密切關係模式，個人需要依賴環境空間中的資源，以求得自身的需求與滿足；環境也需要人類的投入及參與，以維繫自身的生態發展；因此，人與環境間便透過溝通、消費、或保護等互動關係，以獲得永續經營的生存能力。我們需要透過 ICE 學會認知、管理、與保護有關「豐富學習育樂院(PLAY)」中的有限資源，尤其在「節能減碳」的知能部份，以永續經營我們的生命空間。

ICE 的活動以 6 次的減碳能源營隊的方式進行，透過「ICE 促進/結合能源農村」的解說、參觀、實做體驗、討論及分享等活動，瞭解人與環境間能源減碳的生活經驗和技術，以建立對減碳能源教育的認知及保護個人與環境溝通的態度。每梯次活動後，我們進行活動本位方案評鑑(event-based evaluation)，並進行資料分析工作。結果發現：(1) 參與者從親身體驗中，「寓學於樂」地建構環保、節能減碳、及再生能源等環境教育的知能；(2) 參與者能自本活動中，藉由親身體驗而達到認識自我、所處的農村經濟生態、及自我與經濟生態間的緊密關係，從而學習到惜福愛物、珍重環境的深刻經驗與體會；(3)本計畫之 PLAY 及 ICE 模式能對學校教師提供另類的統整式環境教育的教學模式。

(95) 論課程改革背景下的師範生科學素養教育

作者: 李偉, 中國

我國當前的基礎教育課程改革把培養學生的科學素養擺到了重要的位置。科學素養培養已成為科學教育家和大多數理科教師的共同理念，成為當今理科課程發展的一個共同趨勢。怎樣提升師範生的科學素養，滿足基礎教育課程改革對未來科學教師內在專業結構的要求，最大限度地保證教師專業培養水準並為教師自身專業可持續發展打下良好的基礎，為此我們在調查研究的基礎上，對理科師範生的課程設置、教學模式方法等方面進行了改革和實踐，設計的課程和宣導的教學模式方法旨在使師範生能夠在任職初期便能勝任科學課程的教學，實現課程改革的目標。

(106) 國小二年級學生動物園生物多樣性科學探究

作者: 賴慶三, 台灣

生物多樣性是二十一世紀全球重大議題之一，亦是人類永續發展的基礎。聯合國宣佈 2010 年為國際生物多樣性年，以彰顯地球上生命的千姿百態。本研究之目的，在探討國小二年級學生在動物園進行生物多樣性科學探究的學習成效。研究對象，為臺北縣某國小二年級學生 464 位(238 位男生、236 位女生)參與本研究。科學教學內容，包括：教室內的動物主題教學、生物多樣性議題討論、和一天的臺北市動物園校外教學，以利學生對生物多樣性有更多的探究與學習。研究工具，包括學習單與學習回饋意見表。

研究結果發現，生物多樣性科學探究教學活動完成後，有 98.3%的學生對動物園校外教學感到「非常滿意」和「滿意」；有 55.8%和 40.1 的學生表示，對動物的認識與瞭解為「增加很多」和「有增加一些」；有 56.5%和 38.6%的學生表示，對生物多樣性的認識與瞭解為「增加很多」和「有增加一些」；有 56.7%和 39.9%的學生表示，對以後是否還會想要到動物園進行參觀的意見，為「一定會」和「可能會」；而男、女學生對上述問題的回饋反應，經 t- test 考驗後，未達顯著差異。研究結果顯示，運用動物園資源進行生物多樣性科學探究教學，對國小二年級學生在生物多樣性的學習有提昇的作用，值得進一步研究與推廣。

Poster Session 1, 20 December 2010 (Monday), 12:15 – 13:15

(110) How to create teaching cases under the POE teaching strategies from senior elementary mentor teachers

Authors: LU Chow-Chin, WU Hua Shiuan, Taiwan

POE is a kind of effective inquiry instructional strategy that can train pupils to understand inquiry learning, and let them acquire the ability of dealing and solving problems, which are important in learning science and also indication in the 9 year integrated curriculum outlines. In the past, most of the traditional teacher's cultivator institutions emphasis on theoretical analysis of teaching and lecturing, which made pre-service teachers lack of practical experiences of teaching and can't effectively applied their learning to the rapid changes in science teaching field.

This study is about how we train pre-service teachers to use POE teaching strategy in science teaching field when they're in teacher's cultivator institution. Method we use in this study is classroom observation, depth interviews, focus group interviews and CIPP evaluation model to set up the readability for the POE teaching cases. We use purposive sampling (sample decided according to the needs of researcher) and invite three senior elementary mentor teachers which is familiar with POE teaching strategy. We observe their science classroom teaching strategy and converse about how senior elementary mentor teachers use POE in science teaching in depth interviews. Then we conduct a focus group interview, to discuses about how to film and montage a POE teaching strategy teaching case and use it to teach pre-service teachers in their training programs. In order to set up POE teaching strategy cases readability, we use CIPP evaluation model as evaluation. After setting up the teaching cases, we show it to pre-service teachers to let them understand about the problems they might met in teaching. Then, we try to point out a few problems and guide pre-service teachers to discuses about it and apply theory to solve the problems, which can develop their adjust to changing circumstances and ability of problem-solving. This can made up to traditional teaching shortcomings, like understanding the teaching but not being practical. In the end of this study we build a teaching cases and improve pre-service teachers POE teaching strategy. Results shows by using CIPP evaluation model, which have four evaluation period, context evaluation, input evaluation, process evaluation and product evaluation. Context evaluation is according to questionnaire which we observe the difficult science teaching unit and decide to film how senior elementary mentor teachers use POE teaching strategy in it. Period of input evaluation is that we assessment of pre-teachers' demand, confer with research team and decide set up lesson as "material combustion" , "heat conduction" and "action of running water" which can help pupil's inquiry learning and three senior elementary mentor teachers deem using POE teaching strategy in it. Activities as prediction (P), observation (O) and explaining (E) can build or rebuild pupil's concept of science, and teachers can understand what kinds of alternative conceptions pupils will have when learning. When filming teaching cases, researcher not only should notice if teacher's question can guide pupils to predict and assume, observe and record, and explain scientific conception effectively, but also pay attention to the safety items in scientific experiments.

In the period of process evaluation, researcher practically enter the teaching field, shoot senior elementary mentor teachers science teaching, and edit the teaching film according to the spirit of POE, which emphatically point out the key point of POE teaching strategy, have photograph enlarge, adopt a closer look of experiment steps and type the key word to lead and remind users. We use focus group interview, feedback from pre-service teacher to check and correction film. Product evaluation period in CIPP, we utilize hermeneutic method to set up the clarity and readability of the paper.

(112) The longitudinal investigation of a collaborative curriculum to promote Taiwanese underrepresented secondary school students' self-development and interests in learning science

Author: HONG Zuway-R, Taiwan

The purpose of this longitudinal quasi-experimental was to investigate the significant effects on improving underrepresented junior high school students' self-development, interests in science learning, and inquiry ability in Southern Taiwan. This study included three school semesters, in the first semester, we conducted art and humanity integrated activities for experimental group students; in the second semester, an integrative science intervention was conducted for the experimental group students, in the third semester, a small group counseling was adopted to inspire underrepresented students' psychological development and interest in learning science.

Forty-three students (i.e., including 16 target children who are underrepresented students, and 27 general students) were either nominated or randomly selection as experimental group; the other 58 students from the same school were randomly selected as the control group. A total of 101 students completed the pre-test and post-test in each semester. The 16 target students were observed and interviewed for triangulation and consolidation at the beginning and at the end of each semester. The initial findings of the multiple approach method revealed a positive impact on the participants' learning in science and psychological performance as follows:

1. During the first semester of the art and humanity integrated intervention, we found that the experimental group students showed no difference from the control group in the self-worth category; whereas, they have significantly less social skills than the control group students.
2. During the second semester of the integrative science intervention, we found that the experimental group students showed significantly higher mean scores compared to the control group students in self-worth, interests in science, and inquiry ability.

Of the 16 target students that continued participating in the two semesters of intervention, their Big-five traits of Extraversion and Agreeableness traits were slightly higher than before, but not statistically significant. However, there was significant score improvement in the control group. The Conscientiousness trait of the experimental and control group both showed improvement. In addition, the trait of Neuroticism in the experimental group lowered significantly over the course of the semester, while the control group stayed the same. The Openness trait of the experimental group increased significantly over the course of the semester, while the control group's Openness trait was only slightly higher than before.

3. Of the 16 target students with continuous participation into the third semester of the small group counseling intervention, we found that their traits of Extraversion, Agreeableness, and Openness were significantly higher than the control group. Moreover, their scores were also significantly higher compared to the previous two semesters. Their Neuroticism and Contentiousness scores were significantly lower than the control group. In addition, these target students' social skills, self-worth, and self-efficacy were significantly higher compared to scores of the previous two semesters.

Results encouraged teachers to create greater congruence, richer, more open and supportive learning environments in learning science for the under-represented students. Implications for practices and research were discussed.

(123) Pre-service teachers' professional growth of Big6 skills-information technology integrated into elementary science instruction as an example

Authors: LU Chow-Chin, TAI Wen-Hsiung,
Taiwan

"Case Method" was very significant during the process of teacher education. The elementary school teachers were good at instruction methods and resources because of their experience in teaching science. So they could be the pre-service teachers' mentor teachers. Through the mentor teachers' case method and the professors' theoretical instruction, there were great assistance in pre-service teachers' professional growth of "Information Literacy". The research explored the pre-service teachers' professional growth of information technology integrated into science instruction after understanding professors' theory courses and mentor teachers' case method. By professors' theory courses and mentor teachers' case method, we comprehended whether the pre-service teachers could realize the meaning of information technology integrated into science instruction or not, and we discovered the pre-service teachers' professional growth of "Big Six Skills". "Big Six Skills" included task definition, information seeking strategies, location and access, use of information, synthesis, and evaluation. The major findings are as follows: (1) The professors' theory courses of "Big Six Skills" could both cooperate with mentor teachers' case method well, and reached instruction purposes. (2) Through mentor teachers' case method, the pre-service teachers realized a suitable time, manners and formative evaluation of integrating information technology into science instruction. (3) Most mentor teachers could use "Big Six Skills" of information technology to design teaching plans for science instruction. (4) The mentor teachers also could bring up difficulties and concrete propositions from information technology integrated into science instruction.

Poster Session 1, 20 December 2010 (Monday), 12:15 – 13:15

(131) 後設認知策略對職前教師動機信念、學習策略及教學知識

作者: 林素華, 台灣

本研究有兩個研究目的，一個是發展以後設認知能力發展為導向的教學實習課程；其次是評估職前教師在課程中的學習發展。研究對像是 46 位職前教師，刪除不完整資料後，有女生 23 位；11 位是男生。9 位研究進行時是研究所學生；其餘為大學生。教學實習課程是以後設認知策略的學習與教師專業知能發展作為教學目標的課程。為達成首要目標，課程中把目標設定、監控及反省策略等後設認知策略的學習安排在課程的各學習階段中。全程共 18 週。研究者使用試教表現反省表，教 學發展能力問卷，動機信念及學習策略問卷等研究工具收集量化資料。另外，教師的觀察筆記及訪談資料等，則以分類，歸納再整合的方式，與量化資料結合以瞭解 職前教師的學習發展情形。資料分析結果顯示,PMR 課程對職前教師學科教學知能發展有幫助，不同學習背景及男女學生經 PMR 課程學習獲得相同的學習發展，不同的學習經驗會影響學生在學習策略的選擇與運用。

(154) 創造性問題解決融入科學遊戲的教學成效

作者: 許良榮, 張瑨甄, 常蕙茹, 台灣

「科學遊戲」在科學教學具有潛在的教學價值，但是相關的實徵研究並不多見。本研究目的在探討以創造性問題解決(Creative Problem Solving, CPS)為架構，設計融入科學遊戲的教學之成效。評量內容為「摩擦力、重心」的概念學習，以及「探究能力」的學習成效。研究方法採單組前測-後測設計，並實施延宕測驗，以查驗學習的保留效果。研究對象為國小高年級學生一班 29 人，研究結果發現：（1）概念變學習以及探究能力，後測顯著優於前測（P< .05）。（2）延宕測驗顯示學習成效的保留效果值得肯定。（3）學生對於教學具有高度興趣。（4）由協同教師、學生的晤談資料顯示，教學設計可再精緻化。最後本研究針對科學遊戲之教學活動設計、教學實施及未來研究方向提出數項建議。

(161) 在數學探究教學下七年級學生數學素養展現之探討

作者: 秦爾聰, 陳家鵬, 尤昭奇, 台灣

數學素養(Mathematical Proficiency)被定義為成功的數學學習的一詞，同時，數學素養能被使用在定義在任何年級學生的學習目標(Kilpatrick,2001)。因此，數學素養便提供一個觀察學生數學學習的方向。而由美國國家研究會(NRC)所提出的數學素養，則是以五股數學能力來說明，彼此關係交織如同繩結一般，彼此交纏不能完全切割，這五股數學能力分別為：概念性理解、程式性流暢、策略運用、適性的推論、建設性傾向(NRC,2001)。

本研究主要是在數學探究的課室的情境中，探討經由數學探究教學後，七年級學生的數學素養的展現為何。為此，研究者利用個案研究的方法，實際進入教室現場參與並觀察，經由錄影帶轉成逐字稿並蒐集相關質性資料，期間長達一年。透過質性資料分析後，結果發現七年級學生的數學素養有下列四點: (一)透過臆測來增進數學概念的理解;(二)主動參與討論且能站在他人的立場思考或提出反証;(三)多樣化的解題表徵來詮釋數學問題(四)五股數學素養彼此交織。從研究中發現其與數學學習關係密切，因此，本研究建議若是教學者能建立數學探究的課室以發展數學素養，應對學童的數學學習相當有幫助。

Poster Session 1, 20 December 2010 (Monday), 12:15 – 13:15

(175) 對小學教師科學素質相關因素的調查研究

作者: 何麗, 中國

為了瞭解小學教師科學素質及對科學需求的基本狀況，我們於 2006 年 5 月—6 月在福建省、四川省、山東省、甘肅省開展了"小學教師科學素質與需求現狀"的 調查，共發放問卷 2100 份，收回 1929 份，收回率 92%, 有效問卷 1929 份。調查問卷的設計參考了 2005 年中國公眾科學素質調查問卷和浙江省、安徽省社會人文科學素質調查問卷，以便於比較。將科學素質的內涵由單純自然科學部分擴展為自然科學和社會科學部分。調查表明，小學教師具備一定的運用科學知識處理實際問題的能力；其科學素質水準、以多種管道獲得科學知識的能力、對科學知識的需求體現在年齡、性別、地域方面有不同的特徵。同時，調查還表明小學教師在科學素質方面存在的問題如對科學的認識、科學與社會關係的認識存在模糊性，這些特徵也呈現性別、地域、年齡和學科之間的差別。本文還對提高小學教師的科學素質提出了建議和對策。

(191) 學童的 H1N1 概念理解之研究

作者: 林宇涵, 熊召弟, 台灣

本研究旨在探究國小學童對於新型流感 H1N1 的概念理解狀況以及形成的原因。研究者利用 2009 年～2010 年間來自報紙、電視及網路新聞、衛教宣導手冊 等媒體資訊，透過研究小組（研究者、小學專家教師、研究生、大學教授）的討論，歸納整理成「病毒概念」、「傳染特性」與「預防與治療」三主向度的 H1N1 概念命題敘述及概念圖，並依此發展出半結構式晤談題目以及具有效度及信度考驗的紙筆測驗題。研究發現國小學童對於細菌、真菌、病毒缺乏背景知識，因此對於疫苗的概念顯得薄弱，同時學童對於 H1N1 的致死率受及媒體資訊的過度報導的影響也有過度推測之現象。本研究可提供科學教師在社會發生流行病時，有關微生物、健康、傳染等課程設計以及教學實施的參考。

(197) 動物園-生物多樣性昆蟲探索之研究

作者: 林容妃, 賴慶三, 台灣

生物多樣性賦予地球美好的自然環境，基於對生命的尊重、對地球環境的保育，協助學生認知生物的多樣性，以促進學生在生命與環境教育的覺知，是本研究設計的主要理念。昆蟲種類多、數量多，正是詮釋生物多樣性的最佳代表，因此本研究之目的，藉由實施校外教學活動，帶領學生探索物種豐富之動物園中的昆蟲館與蟲蟲探索穀，落實生物多樣性自然保育的理念。研究方法採實徵研究，搜集量化資料與質性資料，以進行分析與解釋。研究對象為臺北縣某國小四年級學生 230 人，研究工具包括「動物園生物多樣性推展態度量表」，有 15 題，Cronbach's α 值為.80，探討學生對動物園生物多樣性推展態度的表現。研究結果發現，實施動物園生物多樣性校外教學活動：(1)能有效提升國小學童在生物多樣性推展態度的正向表現。(2)能有效增進學生在生物多樣性有關昆蟲的概念學習。(3)能增進一般教師在推廣生物多樣性保育的覺知。

(206) 以「使用者為中心」設計自然與生活科技影片式輔助教材之實務研究

作者: 彭文萱, 熊召弟, 台灣

二十一世紀資訊時代的來臨，現代教學者對於教學輔助教材的需求，也符應資訊融入教學的理想，結合了科技的設計。因此，如何製作出符合教學者所需，且方便運用於自然與生活科技領域的影片式輔助教材，是本研究欲探討的重點。本研究以使用者（教師）為中心之理念，透過整合教師的使用需求，並藉深入訪談來剖析諮詢教師的意見，而後專業的研發及製作團隊再據此分析來設計發展影片式輔助教材，繼之再由評鑑教師進行優劣評估，檢核製作產品之成效。結果顯示以使用者為中心的設計模式，所製作出的影片式輔助教材能符合教師需求，便於教學使用，並能彌補教學資源之不足，有效給予教師在課堂上的協助，並於使用者回饋評估上呈現高度肯定。本研究亦發現以使用教師為主的設計，同時也必須兼顧學童的學習完整性，故建議教師必須將教學輔助教材加以備課及轉化後，以輔助教學的形式運用於課堂上，如此將能有助於國小學童在自然與生活科技領域上的學習。

Poster Session 1, 20 December 2010 (Monday), 12:15 – 13:15

(214) 以臆測為中心的探究教學對高中學生數學素養影響之研究

作者: 秦爾聰, 劉致演, 楊讚文, 台灣

本研究旨在探討如何透過以臆測為中心的數學探究教學活動，協助高中學生達到成功數學學習的目標。NRC (2001) 認為成功數的數學學習是學習者具備有嫻熟的數學素養(mathematical proficiency)，此素養是一種交織的五股能力包括概念理解(conceptual understanding)、程式流暢(procedural fluency)、策略運用(strategic competence)、適性推論(adaptive reasoning)以及建設性傾向(productive disposition)等。有鑑於此，研究者以線性規劃單元為主題，並藉由數學臆測的思維中基於可錯論(fallibilism)的觀點，引導學生透過社會建構的方式發現數學猜想中可被反駁的瑕疵，並在猜想、驗證、相信與反駁的歷程間，探討學生數學素養之發展歷程。本研究以行動研究的方式進行，並在二次研究教學循環中分別選取當學年度高三學生 26 位及次學年度高二學生 36 位，進行質性資料的蒐集與分析。

研究結果發現在學生在熟悉數學臆測活動的過程中，教師時需適時的介入及引導，包括協助學生進行驗證其數學猜想中的瑕疵，或是透過提供反例藉以反駁其猜想，以促進學習者臆測思維之精緻化。研究設計中採異質性分組，透過合作解題使學生在協商及溝通中提升其適性推論的能力，並在與同儕的質疑與辯證的歷程間，驗證其數學猜想並進行彈性的策略運用，同時，學生能進一步理解數學概念及嫻熟相關的數學程式，最終，由於各項能力得到提升，其數學建設性傾向亦得到正向的發展與肯定。

(246) 廣州市“科學小星星”專題探究活動的實踐與探索

作者: 馬學軍, 中國

探究性學習是新科學課程標準所宣導的一種學習方式，它能讓兒童像科學家一樣自己動腦動手開展課題研究，是學習自然科學知識的一種重要方法。2003 年開始，廣州市在各小學開展了“科學小星星”專題探究活動，並每兩年舉行一屆成果評比暨大型展示活動。該活動的目的，是為了活躍科學課程的學習氛圍，激發廣大小學生學習科學的興趣，促進他們的科學素養的發展。

在此活動中，學生進行的科學專題探究，以小課題的形式開展。我們特別注重學生研究課題的選題和方案設計。其課題的選題要求遵循以下原則：探究的問題是來自于學生日常生活，並可以通過探究解決；探究的過程須為學生力所能及；探究的問題是學生感興趣的；探究材料容易得到，方法簡便易行。

經過 7 年的探索和實踐，現在已經形成了較成熟的組織方式，並形成了一批有品質的學生探究成果。近年來，部分優秀成果還應邀到香港參加“‘常識百搭’科學專題探究展覽”，與港澳同學進行交流，並屢獲好評。

(252) 國小五年級學生的對溶解的圖形表徵之初探研究

作者: 陳景期, 盧玉玲, 連啟瑞, 台灣

本研究旨在探討學生對文本中之文字表徵轉換為自我圖形表徵之情形，以及自我圖形表徵及溶解的微觀粒子概念理解之間的關連。研究對象為臺北縣某國小五年級學生共 129 人。研究方法先請學生經由文本中之文字表徵認識溶解的微觀粒子概念，並將溶解的文字表徵轉換為學生描繪的溶解的微觀粒子概念的自我圖形表徵。再以兒童之繪圖、圖形敘述及訪談方式蒐集有關溶解的微觀粒子概念的想法。研究的結果顯示，兒童描繪溶解微觀粒子概念的自我圖形表徵可分成五種類型，包括：均勻混和(26.36%)、聚集(23.26%)、結合(11.63%)、包覆（11.63%）、化學變化（1.55%）。另外有 25.58% 的學生無法畫出溶解的微觀粒子概念的自我圖形表徵。分析結果顯示，學童對科學文本中文字表徵所轉換描繪出的自我圖形表徵呈現多樣性，並會影響學生對文本的解釋及概念理解。

Poster Session 1, 20 December 2010 (Monday), 12:15 – 13:15

(266) 臺灣中學奈米科技課程建構之探究

作者: 于曉平, 李乙明, 台灣

臺灣由 2003 年起推動奈米國家型計畫，包含學術研究、產業技術、核心設備建置與人才培育等四大區塊，繼而從邀請 7 所中小學教師擔任種子老師，進行奈米科技專業培訓並進行適合於朱小學學習的教材編寫，隔年設置北、中北、中南、南、東等五個區域 K-12 奈米教育推廣中心，至 2008 年研發設計有許多書籍與多媒體教材，並辦理許多研習、營隊活動進行推廣。為讓奈米科技教育的推展更嚴謹精緻，2009 年加入科學教育的基礎研究，針對各教育階段奈米科技課程的研發與指標的建立進行研究，以作為奈米科技教育推廣之基礎。

本研究位探討臺灣中學奈米科技課程之重要概念與課程之建構，邀請過去參與奈米科技教育的種子老師組成研究團隊，先行彙整過去六年種子老師發展之奈米教材中的關鍵概念，並依此設計成調查問卷，其次，透過三次循環的 Delphi 技術，邀請 20 位奈米科學、科學教育方面的學者專家與具奈米科技教育經驗的中學老師協助調查問卷的填寫，三次調查包括：重要概念的調查、重要程度的評比，以及國中與高中奈米科技課程之初步架構，透過整理與分析，形成國中與高中奈米科技課程架構與教學應用參考範例，以作為後續推廣中學奈米科技課程之參考。

(284) 漢、英語科學新聞論述之分析比較

作者: 黃柏森, 楊文金, 台灣

本研究旨在從語言分析的角度，初探漢語與英語的科學新聞論述特質及其差異。讀者離開學校後，最常由科學新聞中獲得科學新知，而科學新聞文本以援用編譯稿之情形偏高。因此，本研究立基於系統功能語言學（SFL）之理論，以英語科學新聞與經編譯後之漢語科學新聞各一則為標的文本，嘗試從小句事件、詞彙密度、以及語意位階的遷移情形等向度來分析漢、英語文本的論述特質及其差異。研究發現，不論漢、英語的科學新聞皆經常出現鑲嵌句型，此可能為科學新聞之論述特色之一。其次，漢、英語科學新聞之蘊含事件量沒有顯著差異，但漢語科學新聞在論述事件時，經常使用虛動詞來輔助，造成漢語科學新聞使用的字數明顯較英語科學新聞多。相對於英語科學新聞而言，漢語科學新聞的某些論述有歐化的現象，且常使用經包裝後的複雜名詞組，這些複雜名詞組容易在語意上造成曲解。冀望本研究之結果可供科學新聞文本閱讀、編輯等方面的參考，並期待後續研究對科學新聞的論述議題有更多的重視與討論。

(298) 國小學生自然科學合作學習能力之初探

作者: 李欣樺, 連啟瑞, 盧玉玲, 台灣

本研究之目的旨在探討國小高年級學童自然科學之合作學習能力之發展，融合菲力普六六(Phillips 66 discussion 模式）、拼圖法第二代（jigsawⅡ）以及 TGT 小組遊戲區分法(Teams-Games-Tourament TGT)之特色，採用 Avid W. Dohnson 和 Roger T. Johnson 提出，黃政傑（1996）歸納之合作學習之特質—異質分組、積極互賴、面對面的助長式互動、個人績效的建立與評鑑、人際技巧、團體歷程……等。本研究參考劉彥宏（2007）及台灣的九年一貫自然與生活科技課程中合作學習能力之相關指標，發展「國小高年級自然科學合作學習量表」並進行專家效度、重測信度、內部一致性等考驗，研究中並配合自我發展之合作學習狀況檢核表（教師用)，探討教師與學生對於合作學習狀況之認知是否一致。本研究主要採調查研究法，實驗對象為桃園縣國小高年級學童，以 6 個班約 200 位學童進行量表施測，本研究之研究方法以量化研究為主，輔以資深國小教師等專家等質性資料。研究資料經統計後分析、討論，探討小組異質性、互賴程度、助長性互動、個人績效、人際技巧等因素影響學生合作學習能力之情形。

(321) 中學生力學概念轉變的心理機制研究

作者: 胡衛平, 中國

本研究通過對中學生力學概念轉變的教學，探討了中學生力學概念轉變的心理機制。研究採用定性與定量相結合的方法，綜合應用實驗法、測驗法、訪談法、反思法等多種方法。選取城市普通中學高一年級一個重點班和一個普通班的學生作為研究被試。結果表明中學生力學概念轉變的心理機制有：（1）中學生力學概念的轉變方式：抽象概括、邏輯推理、聯想對比、實例演繹、變式思維、實驗推導、理解接受。（2）中學生力學概念學習的認知發展路徑：漸進式發展路徑、跳躍式路徑、滯留式路徑、退進式路徑。

Poster Session 1, 20 December 2010 (Monday), 12:15 – 13:15

(329) 教科書中科學探究的教學目標設定工具的設計

作者: 馬冠中, 胡炳元, 中國

理論與實踐研究發現，現行科學（或分科）教科書中的科學探究存在諸多問題，與科學探究設計過程明確化、系統化的缺失有關。筆者提出，教科書中科學探究的設計過程依次經歷教學目標設定、探究過程設計、探究評估設計及調整與修訂等環節，而本文主要解決科學探究的教學目標設定問題，旨在設計科學探究的教學目標設定工具，服務於課程教材編制人員，輔助科學（或分科）教科書中科學探究的設計。工具的結構類比 Bransford 和 Stein 的五階段 IDEAL 問題解決模型，對應問題解決的階段、專業知識背景及元認知機制，設置設定層、資料層與記錄層。其中，設定層包括教學目標設定引導模組與自檢調整模組，資料層包括教學目標設定輔助資源庫與參照標準庫，而記錄層為教學目標設定過程記錄模組。各模組間相互關聯，各自承擔不同的功能。該工具支援下教學目標的生成須經歷目標設定、過程記錄與資料更新三個步驟。實際使用證明，該工具能夠實現探究活動特性的多指標調控，細化處理探究活動的目標要求，進行自檢與調整，及記錄目標設定過程與預設目標特性等功能。該工具在教科書科學探究設計過程的明確化與系統化方面做出了嘗試，是對提高教科書編制科學化程度的探索。

(342) 國中課後輔導班生生活化生命科學議題線上論點演變及論點來源之研究

作者: 辜千芳, 台灣

本研究目的在探討國中學生進行論證時，面臨決策時使用論點來陳述主張的演變狀況，以釐清影響學生做決策的論點及來源。研究中採用 Toulmin 的論證模式檢視支援主張的所有可用證據。以質性分析為主，量化分析為輔，論證要素的編碼參酌 Clark 與 Sampson(2007)使用 Erduran 分類方式所定義之各項要素；論點演變參酌 Jiménez-Aleixandre 與 Pereiro-Muñoz (2005)之研究繪製論點演變圖。研究對象為某課後輔導班國中生共 24 名。以「排毒餐抗癌」及「開發台灣生質能源」兩議題為研究工具。於無名小站部落格平臺進行，在活動後做部分個案晤談。結果發現：論點演變的人數分佈，演變較高，依次為改變、無改變。演變類型，以理由、資料鋪陳的演變的人數多於有條件進行反駁的演變。論點的來源，來自於個人經驗、線上資料查詢、論證活動中同儕的對話。個人經驗中包含了課程學習及生活經驗。研究中學生面臨決策時，學生運用了個人經驗、線上資料查詢統整了整個論證活動中的對話來支持主張，同時置入了新概念。顯示出線上論證有助於學生新、舊概念的整合。

(351) 面向學生生活世界的科學教育改革

作者: 劉德華, 蔡婷, 中國

生活世界是人的精神家園，為科學教育提供了意義基礎和價值源泉，但它也是“無真理的現實”，有待超越。科學對生活世界的抽象化超越潛隱著遺忘生活世界的可能。把生活世界提到首位不僅是走出科學危機的哲學觀念，也是科學教育改革的基本理念。為此，科學教育的改革應該走向學生的生活場景，探究生活中存在的真實問題，越出科學的邊界，探究非科學的問題，還原科學家的人性。

Poster Session 1, 20 December 2010 (Monday), 12:15 – 13:15

(359) Studying the transients for understanding of some challenging topics in physics

Author: FOONG See Kit, Singapore

Transients are often not emphasized in standard treatment of a topic as they are regarded as complicated. Consequently, attention is focused on the steady state of the phenomena. We argue, through examples drawn from electricity and mechanics, that studying the transients may be necessary for the understanding of some challenging topics in physics. The examples from electricity are the voltage-current phase difference in RC and RL circuits, and the example from mechanics is the modified Atwood's machine. In ac circuit analysis, the phase relationship between the voltage and the current is one of the key concepts. In textbooks, two standard statements 1) the current leads the voltage by in a pure capacitor and 2) the current lags the voltage by in a pure inductor are emphasized and illustrated with graphs. Students may be left wondering how these phase differences arise. In graphical representation, it is shown that just when the voltage is switched on and still zero, the current is already at its peak. A peak current at the beginning is clearly unacceptable simply from energy conservation argument. These difficulties are resolved by including a resistance R which must be present in any real circuit containing the capacitor or the inductor, and by a detailed examination of the initial transients. We show that the current grows from zero, the phase difference also grows from zero and becomes established fully only in the steady state.

The modified Atwood's machine, as illustrated, consists of two masses m1 and m2, joined by a string which passes over the support at O. The string is assumed to be unstretchable and massless, and the support at O and the table top are smooth such that friction can be ignored. Initially m1 is held by hand, and the tension of the string is. Students are often asked to describe the motion of the masses when mass m1 is released. The common accepted answer is that when mass m1 is released, both the masses would move together with a common velocity and a common acceleration given by such that the tension of the string is. This answer does not shade light on how the tension changes discontinuously from to. I first show theoretically that for a real (stretchable) string the tension actually oscillates, with as the mean. The treatment involves ordinary differential equation at introductory level. The theoretical results were verified by experiments with a data logger, using an ordinary cotton thread. The implications on the motions of the masses will be discussed and if time permits, demonstrated as well.

(360) "非常規"實驗設計理念在教學中的價值

作者: 林曉潔, 中國

本文提出"非常規"實驗設計的理念，主要是在常規物理實驗的基礎上加入一些非常規設計。在此以單擺實驗為例，設計了基於資料獲取器的"非常規"實驗，創設了不同的物理情景，讓單擺在擺動的過程中分別在正下方位置和偏離正下方位置給予阻礙，研究單擺的週期的變化情況，並與沒阻礙的情況下得到的週期圖像進行比較分析，使學生在實驗和分析過程中對單擺的擺長 L 和週期 T 之間的關係有更深刻的瞭解。"非常規"實驗設計增加了實驗的趣味性和可研究性，提高學生的學習興趣，也使學生對規律的理解更加深刻。同時，"非常規"實驗設計也幫助學有餘力的學生在做好常規實驗的基礎上進一步發散思維，提高自己的能力。

(363)《中學物理課件設計與製作》課程建設與教學改革實踐

作者: 熊天信, 周曉林, 謝林華, 中國

《中學物理課件設計與製作》是為師範類物理學專業開設的教師素質類課程，在我校已開設十餘年，2010 年被評為四川省精品課程，對該課程的建設與教學改革我們作了如下工作：

一、改革教學內容和方法

1．從物理專業學生實際出發，整合教學內容，淡化理論，突出實用性，精簡教學內容；

2．在教學內容的選擇上，突出專業性與針對性；

3．不斷更新教學內容和教學軟體，確保教學內容的先進性；

4．加強學生動手能力和實踐能力的培養，著力提高課堂教學的有效性；

5．以科研促教學，不斷提高教師的業務水準和教學品質。

二、加強教學手段現代化

在教學中，充分利用多媒體和網路教學，建設並完善了課程網站，學生可自主學習，線上測試，並與教師進行交流；整理了學生的優秀作品和教師課件作品，供學生學習參考。

三、調整考核方式，注重對學生學習全過程的評價

對學生的評價主要分三個方面：1、考勤及課堂問答（占總成績的 10%）；2、學生平時作業，要求完成一個物理動畫製作和一節中學物理內容的課件製作（占總成績的 20%）；3、期末理論考試，主要考查學生對課件製作的基本理論，相關軟體的基本使用方法的掌握情況（占總成績的 70%）。

(366) 對科學素養的要素與結構分析

作者: 李亦菲, 中國

雖然有關科學素養的思想在20世紀初就已有萌芽，但直到 20 世紀 50 年代，“科學素養”作為一個詞彙才出現在日常和學術交流中。20 世紀 60-80 年代，科學教育工作者對科學素養的概念進行了廣泛的探討，提出了有關科學素養的許多定義和解釋。80 年代後期以來，世界各國都從提高公眾和青少年科學素養的角度，採取措施推動科學教育，並對科學素養提出了各自的解釋，進一步豐富了科學素養的內涵。然而，直至今日，人們對“科學素質”一詞的理解仍然莫衷一是。從名稱上看，有“科學素養”、“科學素質”、“科學技術素養”等各種不同的說法；從內涵上，也沒有形成統一的界定。根據對“科學素養”一詞的語義分析，可以將科學素養定義為“涉及到科學內容的讀和寫的能力”，並通過將科學的三個方面（“科學過程與方法”、“科學知識”、“科學應用”）與“素養”的兩個方面（“讀的能力”、“寫的能力”）進行組合，形成科學素養的“六要素模型”。這一模型有助於系統地建立青少年科學素養的評價標準和測評方案，對於克服我國目前青少年科技教育中的“應賽”傾向，促進青少年科技教育普遍、持久、有效地開展，具有重要的意義。

(370) 科學史科學社會學教育融入小學課程的研究

作者: 林海燕, 中國

小學階段科學素養的培養不僅僅限於“科學”課程，用統一的角度看待小學課程和教材的教與學。提倡用先“融入”而後“化”的思維方式將科學史-科學社會學教育融入小學課程，課程實施中注重細節，避免非科學的簡化史，注重體驗，讓歷史動起來。教師要做好科學素養、教育能力和心理學測評方法等方面的準備。

Poster Session 2 - Abstract 海報展覽 2 – 論文摘要

Poster Session 2
Date: 21 December 2010 (Tuesday)
Time: 13:15 – 14:15
Venue: Outside area of room D1-LP-02

(93) 南台灣奈米教育推廣現況

作者: 林仁輝, 黃台珠, 陳元方, 林弘萍, 陳錫添, 張素瓊, 陳東煌, 馮榮豐, 蔡振章, 賴顯松, 陳訓祥, 陳芳怡, 台灣

臺灣於 2002 年底推動第一期「奈米國家型科技計畫」,由教育部統籌執行「全國奈米科技人才培育計畫」,全臺分成五區，五區中各有中小學(K-12)及大學前瞻等兩個面向，執行全面性奈米科技人才培育與推廣。自 2003 到 2007 期間,計畫成果包括: 奈米教材、出版品、種子教師數、夥伴學校數、活動次數、相關學程及各式發表等，而南區計畫成果，除學程開設數外，佔整體計畫成果近 1/3，在五區中表現領先。在第二期「奈米國家型科技計畫」中，南區近一步整合 K-12 及大學前瞻人才培訓並以培育全方位奈米人才與推廣奈米科技為目標，達成(1)K-12 奈米教育課綱訂定、(2)國民奈米科技核心素養調查與提升、(3)符合產業需求前瞻奈米人才培育、(4)奈米科技教育向下紮根、(5)產學合作案媒合與推動，及(6)全民奈米科技知識建制與推廣等目標。本研究將針對目前計畫執行成效給予評量並做為後續計畫執行參考。目前執行成效方面，我們認為這計畫有以下特點，值得與大家分享並接受回饋意見: (1)計畫人才含蓋 K-12、大學及研究所學生並與產業結合，對人才養成與運用有一貫性; (2)計畫導入概念圖、活動評量等科學教育工具，提升活動效率與品質; (3)導入產業項目並針對特定產業奈米技術有研究專題計畫產出; (4)計畫擴及離島及偏鄉學生，具普及性。

(97) Using asking questions to explore young children's views of sounds

Authors: CHIU Hsueh-Mei, KENG Hsiao-Tseng, LU Chow-Chin, Taiwan

The study explores first-grade students' conceptions of sounds by separately asking five-sensory feelings questions in a human constructivist view. Few studies have been done on questioning in the early years of schooling, since students of this age are usually considered to unable to deeply construct or understand the concept meanings. Some researchers recommend that a meaningful learning would be practiced in children's cognitive view. Hence, the study is based on the theory of the human constructivism to explore the effects and to elucidate how separately asking five-sensory feelings questions affect students' communications and concept learning.

This study adopts a qualitative method and acquires revised data utilizing the pilot study. Participants of the pilot study are second-grade students. The formal participants are first-grade students at a school in Taipei County, Taiwan, and are from working-class and middle-class backgrounds. There are thirty students in a class and eleven students are selected to interview by the researcher.

The data sources are interview transcripts, the worksheets, the teaching records of taping. In addition, the sequences of teaching materials are transformed acceptable models in a learner-centered perspective. Then, interview questions are divided into several sensory parts such as sight, hearing, touching, or feeling. Through the design of questions, not only children easily describe their ideas in their mind, but also the researcher combine children's responses of five-sensory feelings questions to acquire an integrative understanding.

First, the results indicate children can easily link the string to the telephone wire, so they can understand that sound is traveled by the string. By contrast, they think that sound is not traveled by wooden table because of the shape of wooden table dislike the string. Second, they few link the relationship between sounds made and the vibrations of matter. Children separately are aware of feelings of vibration and phenomena of sounds arising from vibrations, but they do not think there are relationships each other.

In conclusion, separately asking five-sensory feelings questions assists young children's interactions and capacities with explanations. Children can easily communicate with the external world and not constrained with the skill of whole expressions. Then, the researcher can acquire ideas close to children' internal minds through the method integrating their responses of separate five-sensory feelings questions. When children are encouraged to response, revise and dialogue through the design of questioning, they are able to express and explore increasingly complex ideas.

Poster Session 2, 21 December 2010 (Tuesday), 13:15 – 14:15

(109) 國小五年級專題本位天文教學之研究

作者: 賴慶三, 高玉娟, 台灣

本研究之目的，在探討以「太陽的觀測」與「夏季星空」為主題，進行專題本位天文教學之成效。研究對象為臺北市某國小五年級的兩個班級，實驗組與對照組各有 35 位學生。實驗組採取專題本位天文教學，對照組則依教科書教學指引進行一般教學。研究工具包括「天文評量測驗」與「科學態度量表」。教學活動實施前後，兩組學生經施以前、後測，進行單因數共變數分析。並輔以晤談、學習單、檢核表等質性資料，以分析專題本位天文教學之成效。

研究結果發現，包括：(1)實驗組學生的「天文評量測驗」表現優於對照組，F=4.460，達 p＜.05 的顯著水準，顯示專題本位天文教學能有效提升實驗組學生天文概念學習成就；(2)實驗組學生的「科學態度」表現優於對照組，F=6.692，達 p＜.01 的顯著水準，顯示專題本位天文教學能有效提升實驗組學生的科學態度；(3)實驗組學生經過專題本位天文教學的各階段學習歷程，學生表現出能充分應用科技認知工具合作設計多元的活動，展現其學習成果，如簡報、遊戲、戲劇表演等，統整了星座故事內容與天文概念，使得各組作品展現了不同的特色。

(111) 浙江省在職初中科學教師 PCK 現狀調查與分析

作者: 任山章, 金建敏, 陳志偉, 中國

學科教學知識（PCK），是教師知識的重要組成部分，瞭解與研究教師 PCK 構成狀態，對於促進教師的專業發展，促進教育終極目標的實現具有重要的現實意 義。本研究採用問卷調查法，瞭解並分析浙江省部分在職初中科學教師的 PCK 現狀，擬為有關部門規劃科學教師的培訓提供依據。調查結果表明：①從“科學課程 知識”維度看，科學教師的科學史知識較缺乏，對科學本質觀的認識還不太全面。②從“對學生瞭解的知識”維度看，大部分科學教師在對學生身心發展情況、探究 技能水準上還缺乏足夠瞭解。因此，在教學準備上還缺乏對學生先備經驗的考慮，足見其在綜合運用教育心理學知識促進教學實施方面還較欠缺。③從“科學教學策 略知識”維度的統計與分析得知，初中科學教師未能充分運用教學資源進行有效教學，在依據教學目的設計課堂情境方面還有待提高。④從“科學素養評價的知識” 維度看，目前大部分科學教師的評價方式比較單一，在統計並分析評量結果，促進有效教學方面也做得很不理想。從上述四個維度分析，浙江省在職初中科學教師的 PCK，整體欠缺教育理論知識支持。統計分析還表明，在不同性別、年齡、教齡、學校位置、學校類型、學歷等諸因素中，學校類型和位置對科學教師 PCK 的影 響存在顯著性差異。

(113) 遺傳學學習困難之探究及其在教學上的啟示

作者: 朱幼倩, 台灣

遺傳學的學習有其必要性，但學生在遺傳學單元時的學習成就普遍較低，對於遺傳相關認知也明顯存在許多另有概念。本研究欲藉由文獻回顧來分析可能造成遺傳學 學習困難的原因，再進一步分析歸納與實驗確認，並提供相關教材教法的建議，期望可提供給生物教育工作者參考與重視。本研究以立意取樣方式，選取台灣北部三所公立中學一年級學生（13-14 歲）為研究對象，以蒐集分析量化資料為主。結果顯示，學習者之認知發展的成熟與前備知識、遺傳學知識結構的複雜性、涵蓋 跨單元和跨學科間的概念、語言的使用與大量的專有名詞等，皆會影響遺傳學學習；由訊息處理理論的角度來看，工作記憶的有限空間與訊息超載是決定遺傳學學習 成效的主要關鍵。進一步探究影響遺傳學學習成就因數與學生對遺傳學態度之關係，發現學生的工作記憶能力與遺傳學態度中的情意部分較有相關性，而與遺傳學態 度中的認知部分則無統計學上的關連性。最後，建議教學者或教材撰寫者在設計教材時，必須將學習者的工作記憶能力納入考量中；應控制好有用訊息的量於學習者 可以處理的範圍之下，或協助將欲傳遞的訊息作組塊化的策略，以使學習者的學習是具有意義的。

Poster Session 2, 21 December 2010 (Tuesday), 13:15 – 14:15

(130) 提高生物實驗教學質量的有效方略

作者: 邵銀東, 中國

為了較好的適應生物新課程標準的實驗教學要求，必須要在開足實驗的基礎之上，在以下方面狠下功夫：1．不失時機的創造條件，克服學生思維定勢對實驗知識掌握的負面影響。2．變現成實驗程式為"學生自主設計實驗程式"，讓學生進入探究者的角色。3．及時將意外生成資源納入實驗，讓實驗課富於彈性化、開放化，促進教學相長。4．注重學生主動挖掘教材隱含實驗的研究價值，以較強責任感的將探究實驗引向深入；5．採用聯繫實際的方式，使實驗知識得到牽移應用，培養學生學以致用意識。

(148) The use of CD-ROM to explore second-grade students' conceptions about nanotechnology in Taiwan

Authors: CHIU Hsueh-Mei, LU Chow-Chin, SUNG Chia-Chi, Taiwan

This paper described the conceptual understanding of second-grade students about nanotechnology utilizing CD-ROM teaching in the northern area of Taiwan. Because the nano-phenomena of natural world were invisible in eyes, the researcher introduced relevant conceptions utilizing educational technology. The CD-ROM intervention was immerged the nanotechnology instructions on the lotus effect, the effect of colorful butterfly, and nano-magnetic particles, therefore, the researcher could transfer abstract descriptions into concrete images suitable for children's cognition. The study adopted a qualitative, interpretive method and twelve students were interviewed by the researcher. In addition, using a questionnaire composed of contexts and open-ended questions measured the outcomes of students' concept learning of nanotechnology, and provided descriptive data regarded as the basis of further interviews.

Data sources included drawings, interviews, and discussions. Tapes of participants' interviews were used along with drawings and responses during data analysis. The various data were analyzed via a constant comparative method in order to produce profiles of each participants' pre- and post-instruction conceptual understandings of nanotechnology. Results indicated that CD-ROM interactive teaching attracted children's attentions, and stimulated their intrinsic motivation for learning nanotechnology. The situations of CD-ROM could guide children to see related explanations of the nano-phenomena, even if they understood the natural phenomenon without the linkage of nanotechnology. Respite the images and sounds of CD-ROM could reinforce children' sensory impressions for natural nano-phenomena. In conclusion, this study demonstrated that second-grade students thought microworld features of nanotechnology through a macroworld thinking style. The CD-ROM usage could offer children a whole visualization and assist their concept learning in nanotechnology. Hence, a well-designed CD-ROM content can be very effective in promoting scientific understandings.

(159) 以事件相關電位分析法探討大學生對立體化學結構式的辨識差異

作者: 梁騏霖, 蔣秉穎, 黃琴扉, 劉嘉茹, 台灣

本研究旨在探討主修化學與非主修化學學科的大學生，在進行不同立體化學結構式的辨識作業時，其認知表現的差異。研究對象為 19 名自願參加的理學院大學生 （平均年齡 21.2 歲），分別為主修化學者 9 位與非主修化學者 10 位。所有研究對象首先進行化學結構式之問卷，以確認主修化學者有較佳的化學背景知識；然而問卷無法區分兩組研究對象的辨識差異，因此本研究接著進行不同立體化學結構式的辨識作業。本研究利用事件相關電位（ERPs）理論設計作業，讓研究對象辨識二維(Two Dimension, 2D)、三維(Three Dimension, 3D)的化學結構式是否相符合。研究結果發現主修化學者在 3D 的化學結構式辨識中，右腦枕葉與顳葉（occipito-temporal）的電極點上出現 N170（根據 ERPs 理論，N170 的出現可代表研究對象進行特定立體物件辨識時所運用的認知功能），在辨識 2D 化學結構式並無呈現；而非主修化學者則在 2D 與 3D 辨識中均無呈現。此 ERPs 結果顯示，非主修化學者運用相同的策略來辨識 2D、3D 化學結構式；主修化學者則把 3D 化學結構式視為特定立體物件。綜上所述，本研究推論專家與生手奠基於背景知識的差異下，將在大腦中形成不同的視覺表徵辨識策略。

Poster Session 2, 21 December 2010 (Tuesday), 13:15 – 14:15

(166) 綜合科學課程的認識問題與實施策略探討

作者: 王耀村, 台灣

浙江省是我國大陸第一個在全省範圍內實施初中綜合科學課程的地區。浙江省在課程實施過程中的卓有成效探索為我國大範圍推行綜合科學課程積累了寶貴的經驗、提供了有益的借鑒。從浙江省實施綜合科學課程的經驗看，要有效實施綜合科學課程，必須從計畫課程與實施課程的統一來認識初中綜合科學課程的內涵，從社會發展和人的發展的高度理解綜合科學課程的意義，同時運用包括以政策推動促進觀念轉變、以教學研究提供專業支援和以資源建設保障教學需要等綜合性策略來推進綜合科學課程的實施。

(178) 蕨類生態園校本課程發展與實施成效之研究

作者: 王純姬, 台灣

本研究目的在於營造蕨類生態教學園，結合社區資源，以戶外教學方式設計、發展出一套具有學校本位特色的課程，同時，透過教學，探討學生利用此生態園之學習成效，及對學生科學態度與觀察、分類、傳達之科學過程技能的影響。

研究分為兩個階段，先以質性行動研究規劃、營造蕨類生態園，發展、實施學校本位課程，過程中隨時進行省思、討論、修正，發展具體可行的軟硬體；再以單組進行八週教學介入，比較教學前、後學生蕨類相關知識、科學態度與科學過程技能之改變，並深入探討知識、態度與技能學習間的互動關係。

研究結果顯示：(一)蕨類生態園已獲得全校所有夥伴的認同，形成共識，參與成員包括親、師、生。(二)學生在蕨類植物相關知識記憶題、理解題、高層次思考題前、後測皆有顯著的差異，其中理解題得分進步 30%進步最多。(三)學生在科學態度四個分量表：喜歡探討、發現樂趣、細心切實及求真求實，沒有量化的顯著改變。從學生回饋的意見中，發現學生質性的科學態度，有明顯而正向的改善。(四)學生在觀察、分類及傳達科學過程技能，只有觀察科學過程技能有顯著的進步。

(193) 探究進入科學教育館的學生科學學習動機及滿意度的表現

作者: 邱庭煒, 熊召弟, 台灣

本研究主要是探討進入科學教育館的小學生的科學學習動機及學習滿意度之現況及相關因素影響。研究者發展具有效度檢核以及信度考驗的「科學學習動機及學習的滿意度之調查問卷」，含括三部分：(一)個人基本資料、(二)科學學習動機量表(自我效能、主動學習策略、科學學習價值、表現目標導向、成就目標導向與學習環境誘因六向度)、(三)學習的滿意度量表(課程 安排、教師教學、學習態度及學習成果四向度)。問卷對象包括參與科學教育館活動的小學 3 至 6 年級學生約 158 位(男生 91 人、女生 67 人)，透過統計分析，研究發現: (一)科學學習動機層面在「性別」變項上女生的表現優於男生，而在「學校所屬行政區」變項上新北市學員優於其他行政地區；然則學生對於科學教育館的學習滿意度無顯著差異；(二)學生的科學學習動機與學習滿意度整體間呈顯著正相關($r=.279$，$p<0.01$)；(三)學生的學習滿意度層面與動機的「表現目標導向」、「成就目標導向」兩向度無顯著相關。本研究的調查結果可作為社會科學教育學習機構在提升學生動機與滿意度之課程活動或計畫規劃時的參考。

(200) 問題解決模式融入數位元元遊戲設計教學對於國小五年級學童學習問題解決能力之影響

作者: 何雅惠, 盧玉玲, 連啟瑞, 台灣

本研究的主要目的為探討問題解決模式融入數位元遊戲設計教學對於國小五年級學童學習問題解決能力之影響。研究中乃依據文獻所歸納之「問題解決模式融入數位元遊戲」的流程，設計一個實驗性數位遊戲「時空物語」，研究設計以量的研究為主，質的研究為輔，研究對象為國小五年級學生，「實驗組」進行強調問題解決模式的數位元遊戲教學，「對照組」則進行傳統教學。透過學習路徑記錄、問卷、訪談記錄、問題解決能力測驗與預設的問題解決能力目標及學習成效做對照，瞭解該實驗性數位遊戲的教學設計是否發揮增進問題解決能力之功能。本研究的研究結果是，在問題解決的能力上，強調問題解決模式的數位元遊戲教學顯著優於傳統教學，顯示問題解決模式融入數位元遊戲設計教學有助於學生在問題解決能力之提升。

Poster Session 2, 21 December 2010 (Tuesday), 13:15 – 14:15

(210) 以眼球追蹤技術探討板塊概念圖形表徵理解歷程

作者: 侯依伶, 劉嘉茹, 台灣

本研究以眼球追蹤技術來探討科學圖形的理解歷程，選取 45 位自願參加的理學院大學生為研究對象。受試者藉由以板塊運動繪圖測驗以及與針對受試者所繪製圖形進行的放聲思考內容分為 4 種不同的先備概念類型。在眼動實驗中，本研究讓具有不同先備概念類型的受試者觀看相同的板塊運動示意圖片，並以眼球追蹤技術紀錄眼球運動數據。本研究選取第一次凝視時間、回視次數以及凝視順序等眼動數據，探討具備不同先備概念的受試者在科學圖片理解歷程上的差異。以單因數變異數分析與事後比較後，結果顯示不同板塊運動概念先備類型的受試者在觀看板塊運動示意圖時第一次凝視板塊區的時間、對流區的回視次數以及對流區的凝視順序皆有顯著的差異($p<.05$)。本研究結果顯示眼球追蹤技術提供不同面向的生理證據，支援板塊概念圖形中的對流區為關鍵的理解區域，且不同先備概念的受試者在圖形理解過程中眼球運動存有差異，由此可以詮釋圖形理解在概念學習的角色，以作為教學設計和課程發展的依據。

(244) A study on the conceptual understanding of chemistry freshmen in the topics of molecular geometry and polarity

Author: THE Yun Ling, Singapore

This research study aims to identify the conceptual knowledge of first year Chemistry undergraduates in the topics of Molecular Geometry and Polarity. The study was conducted in the two top universities in Singapore. It thus helped to increase the documented data on the conceptual knowledge of Chemistry undergraduates, which are still limited in the Singapore and Asian contexts.

To achieve greater depth to the research findings, data were collected using both quantitative and qualitative methods. The quantitative data on students' conceptual knowledge were determined by statistical analyses on the concept test scores and confidence ratings. Information on students' conceptual understanding and alternative conceptions were revealed from the semi-structured interviews, which served as the qualitative data.

It was found that most Chemistry undergraduates knew the fundamental concepts such as Valence Shell Electron Pair Repulsion (VSEPR) theory, hybridization, molecular geometry and polarity separately but could not apply and integrate these concepts together. They know the "what", but not the "why" and the "how". Some of them successfully applied a formula memorized to derive the molecular geometry of a molecule but not sure how the various molecular geometries were derived from VSEPR theory. About one third of the undergraduates had difficulty distinguishing the difference between "linear" and "planar" structures. Two alternative conceptions were surfaced during the interviews: (i) the more polar the bond, the stronger it is; (ii) lone-pair electrons on the central atom were dipoles. These data thus reveal that some undergraduates were still not clear about the electrostatic basis of chemical bonding and molecular polarity.

(247) 發展臺灣地區國高中奈米科技課程的專家概念

作者: 張慧珍, 香港

「奈米科技」是二十一世紀的新產業革命動力，在全球知識經濟發展的脈絡中，奈米科技的推動對各國產業及競爭力影響既深且廣(工研院，2005)。奈米與我們的生活息息相關，教育民眾對於奈米科技產業具有基本的認識，乃成為當務之急。推廣國中的奈米科技教育及一般民眾對奈米科技之認識，便成為加速推動奈米產業教育不可忽視之一環。

行政院國家科學委員會自民國 92 年推動六年「奈米國家型科技計畫」，期能作為國內奈米科技研究重心；其中「人才培育」為振興啟蔽的基石，希望藉由計畫的推動能培育：(1)領導或執行奈米科技人才；(2)能認知奈米科技潛能，並將其產業化及商業化之人才。本研究以延續「人才培育計畫」為主要目標，以子計畫 A1 之奈米科技課程能力指標之訂定為主，透過文獻資料與相關研究的蒐集，擬定國中學生各階層奈米科技學習的概念為目標，透過學生概念目標的擬訂，作為教師教學活動設計與行為目標擬訂之依據，探討國中學生的奈米科技素養，想藉由發展二階層診斷工具進行國中學生的評量與分析，探討學生所理解的奈米科技概念的學習情形與另有概念形成原因，作為國家未來設計課程綱要與指標的參考依據。

Poster Session 2, 21 December 2010 (Tuesday), 13:15 – 14:15

(255) 國小五年級結合社區資源中心實施環境教育教學探究

作者: 施春輝, 台灣

環境教育是一種為了環境保育而實施的教育。其目的在於教導人類關愛環境、善用自然資源、維護自然生態與文化，並妥善處理相關環境問題。而環境教育之教與學的領域分為三大部份，分別為 1.在環境中進行教與學，2 有關環境的教與學，3 為環境而教與學三部分。因此筆者認為即是在環境中進行教學、學習環境中的知識、以及解決環境問題等三層面。而環境教育實施方法相當多元，實施地點不僅在室內及校園，更可結合社區或周遭之各項教學資源，利用戶外體驗的方式，提供具有意義的教學，並以能促進基本學校課程之預定目標為原則。因此本文是以透過以臺北縣某國小所熟悉的社區資源中心為環境教育的教學場域，並透過青年公園的解說導覽，瞭解青年公園的生物知識，結合 5why 鷹架式提問教學模式，進行國小五年級環境問題解決探究教學。

(282) 創造力教學式之網路遊戲學習法對於學生科學創造性思考之初探

作者: 陳俊宏, 連啟瑞, 盧玉玲, 台灣

在現今知識經濟推陳出新的時代，創造力儼然成為繼知識教育後教育體系當中之翹楚，無論於任何一個學習階段，激發學生創造力教學法已成為教育的趨勢及重點。而網路遊戲對於現今學童的學習與休閒佔有舉足輕重的角色，本研究為建置創造力教學式之網路遊戲之初探，將眾家創造力教學法濃縮成為四個步驟，便於未來裡有意願將數位網路遊戲融入科學教學之科學教師於設計實施創造力教學式的教學工具，以此四個步驟作為教學及研究工具，進行實施此教學法對於實施學生的創造力發展改變及創意想法之研究，以瞭解此創意教學法對於發展學生之創意的成效。研究目的在比較經由此創意教學法教學後學生的科學創造力之認知、情意與技能是否有所改變。研究採前、後測的準實驗研究方法，以桃園市某一國小六年級學生為對象。研究採用「實作活動測驗」和「實作活動測驗後學生訪談」為研究資料蒐集，在實施此教學法前先進行前測，再採以創造力教學式網路遊戲的故事模式為教學模式。研究發現施予此創意教學法教學後學生在科學創造力之認知與情意（學習動機）等能力有顯著提升。

(288) 2007-2009 年科學教育學刊內容分析

作者: 陳韋銘, 連啟瑞, 盧玉玲, 台灣

本研究選定 2007-2009 年科學教育學刊發表之 80 篇論文為研究對象，以內容分析方式探討此學刊論文近三年來之研究主題、研究目的、研究對象、資料蒐集、資料分析方法，同時希望可以藉此分析出科學教育研究相關趨勢做為從事科學研究的研究者參考。內容分析結果發現，研究主題以自然科目領域最多，數學科目領域次之，同時自然科目的研究領域每年都保持最多的篇幅。與教學有關的 54 篇研究中，教學模式與策略是主要的研究目的；與科學素養有關的 36 篇研究中，以科學認知為研究目的占大多數。在研究對象中以研究學生為主，老師次之，另外包含家長及文本，以學生為研究對象的論文中，國中生的篇幅最多，高中生的篇幅最少，且國小階段以高年級學生為國小主要研究對象，除此之外以大專生為研究對象有逐年減少的趨勢。在研究方法方面以量化的研究為主，且準實驗研究法占大多數。本研究發現科學教學與科學素養的研究有集中化的趨勢，建議在未來的研究中可增加教學環境與教學內容載體等硬體方面的研究，畢竟教學硬體也會影響學生的科學學習；同時建議增加科學情意與科學技能的研究，因為科學素養中的情意與技能方面也是影響科學學習的重要因素。

Poster Session 2, 21 December 2010 (Tuesday), 13:15 – 14:15

(311) Form literacy to content language integrated learning: The PAOC Ka Chi Secondary School experience

Authors: CHOW Shui Ying, CHAU Wai Shing, Hong Kong

This paper aims to explore literacy and content language integrated learning (CLIL) in science learning at junior secondary school level in Ka Chi Secondary School. To develop literacy in learning science at junior secondary levels, learning through reading, selected text and writing are employed. Literacy in science focuses on the science content rather than language. While CLIL is a dual-focused educational approach in which a second language, English is used for the learning and teaching both content and language.

Since the educational policy on language fine-tuning, all schools are needed to conduct. English-medium extended learning activities up to a proportion of 25% of the total lesson time while teaching primarily in the mother tongue. School needs to develop indicators to evaluate the learning performance both on content and language CLIL thus provides a platform to integrate learning both on content and language.

In the paper, we tend to explore how CLIL helps student learn better on both the target language and content and ways to evaluate how much they have learned from the target language. To our learners, what problems come from learning second language? Students do not understand key words or sentence structure from the given text is the main problem in learning. Appropriate scaffolding approaches are needed; tools such as visual organizer and graphic organizer are employed to scaffold vocabulary and key words and organize to develop them into short sentence. Through this learning process, learner is able to turn the receptive knowledge to productive knowledge.

Framework of using subject-verb-object pattern helps secondary one learner to develop their skills in short writing through visual scaffolding, verb-object pattern in creating slogan. Secondary three students make use of graphic organizer to find out key sentence from the selected text, organize them and rewrite these key sentences to form a short paragraph. Evidences shown our students make substantial English language gains through these designed tasks. An ideal CLIL curriculum focuses not only on the content, but also considers how well the learners can apply the learned language through oral reporting and writing.

(324) PBL 對網路教育學生學習成績和班級感影響的實驗研究

作者: 鄧磊, 中國

以問題為基礎的學習是一種可以用於網路學習環境的教學策略，其以建構主義理論為支撐。本研究主要調查的是 PBL 對線上學生班級感和成績的影響。

本研究關注的是大學科學教育專業《中學科學教育》課程中的線上課程設置。結果顯示，通過 PBL 專案,學生會感到同學之間的聯繫更緊密。他們在後測中獲得了更高的分數，不過他們的線上期中和期末考試分數上與控制組沒有太多的差異。

(335) 臺灣國中小數學教科書之銜接性分析：以統計與機率主題為例

作者: 王馨梅, 吳心楷, 台灣

臺灣九二課綱將數學學習領域分為五大主題，過去研究多針對數與量、幾何等主題進行分析，較少涵蓋統計與機率的內容，且國中小數學課程內容的銜接性，一直是課程發展的重要議題。因此，本研究目的為透過分析架構評估不同版本教科書，在統計與機率主題內容的銜接性。根據文獻本研究將課程銜接性定義為：教科書需依課程綱要完整呈現理想次序的學習內容，並符合相同概念再次出現的原則。本研究採內容分析法，對象為臺灣教育部審核通過的數學教科書，依市佔率挑選出三種版本（南一、翰林與康軒）。分析架構是以九年一貫課程數學領域的課程綱要和分年細目為基礎。研究過程中藉由專家效度、同意值、追溯檢核等策略驗證本研究信實度。初步結果顯示，各版本呈現次數較多的概念有製作統計表、報讀統計圖等；翰林與康軒版在內容呈現類別較為一致，教師演示與學生練習的事件比例約為1：4，南一版在學生練習的事件比例較高。另外，各版本無法達到理想化的銜接性，概念的重複次數及分佈不均，且內容編排的順序與分年細目有所出入，如：翰林及南一版皆將九年級應學的平均數、中位數與眾數概念提早至六年級。本研究結果可做為教科書編排及教師教學之參考，以期能完整呈現該主題概念的意涵。

Poster Session 2, 21 December 2010 (Tuesday), 13:15 – 14:15

(346) 香港小學個案分析：應用網誌於記錄科學探究歷程之成效

作者: 羅玉婷, 香港

隨著 Web2.0 技術的成熟、普及與生活化，不少學校會引進這些技術於學教中，當中以網誌為學界所廣泛地使用。由於網誌製作對使用者的技能要求多只限於一般的文書處理，且網誌能支援多媒體或超連結，讓使用者具較多元化的自我表達模式。加上線上工作，讓學生能隨時隨地進行，寫網誌來得更彈性與靈活，流通量也較廣泛。2009-10 年，第十三屆「常識百搭」科學專題設計展覽舉行了第二屆「科學探究研習日誌」活動，好讓學生能善用網誌的優點記錄他們在科學探究中的歷程，製成學習檔案，供校內、外同儕分享與觀摩。在是次活動評審中，發現及比較了七份提交作品在探究目的、過程與步驟、記錄形式與手法及多媒體運用等度向上的相異處，從而釐出學生對應用網誌於科學探究歷程記錄上之成效。

(364) 分科教師對推行綜合科學課程看法的調查研究

作者: 胡繼飛, 中國

為瞭解在職初中分科理科教師對推行綜合理科課程的認識和意見，採用自編問卷對 518 名廣東省初中分科理科教師進行了問卷調查。結果表明：

1、多數教師贊成全面或大面積推行綜合科學課程。是否贊成推行綜合科學課程，在不同科目、不同教齡教師之間存在極明顯差異，贊成者中生物、地理學科教師明顯多於物理、化學學科教師；教師教齡越長，對推行綜合科學課程的認同度越低。但發達地區與非發達地區教師之間沒有表現出明顯差異。

2、多數教師願意教分科理科，只有約 1/5 的人選擇願意教綜合科學課程。是否願意教授綜合科學課程在不同科目、不同教齡之間表現出極明顯差異，生物、化學教師的積極性明顯高於物理、地理教師；教齡越長越不願意教授綜合科學課程，而更願意教授分科理科。但發達地區與非發達地區教師之間沒有明顯差異。

3、受訪教師認為綜合科學課程的主要障礙依次為“教師不太勝任教學”、“考試和評價的不配套”、“領導不重視”和“教學設備投入不足”。發達地區與非發達地區教師之間在這個問題上的看法存在極明顯差別，但不同科目、不同教齡教師之間並無明顯不同。

4、絕大多數受訪教師贊成分步推進綜合科學課程，並認為應該採用“先發達地區後欠發達地區”和“以中心城區帶動周邊地區”的方式來推進綜合科學課程。

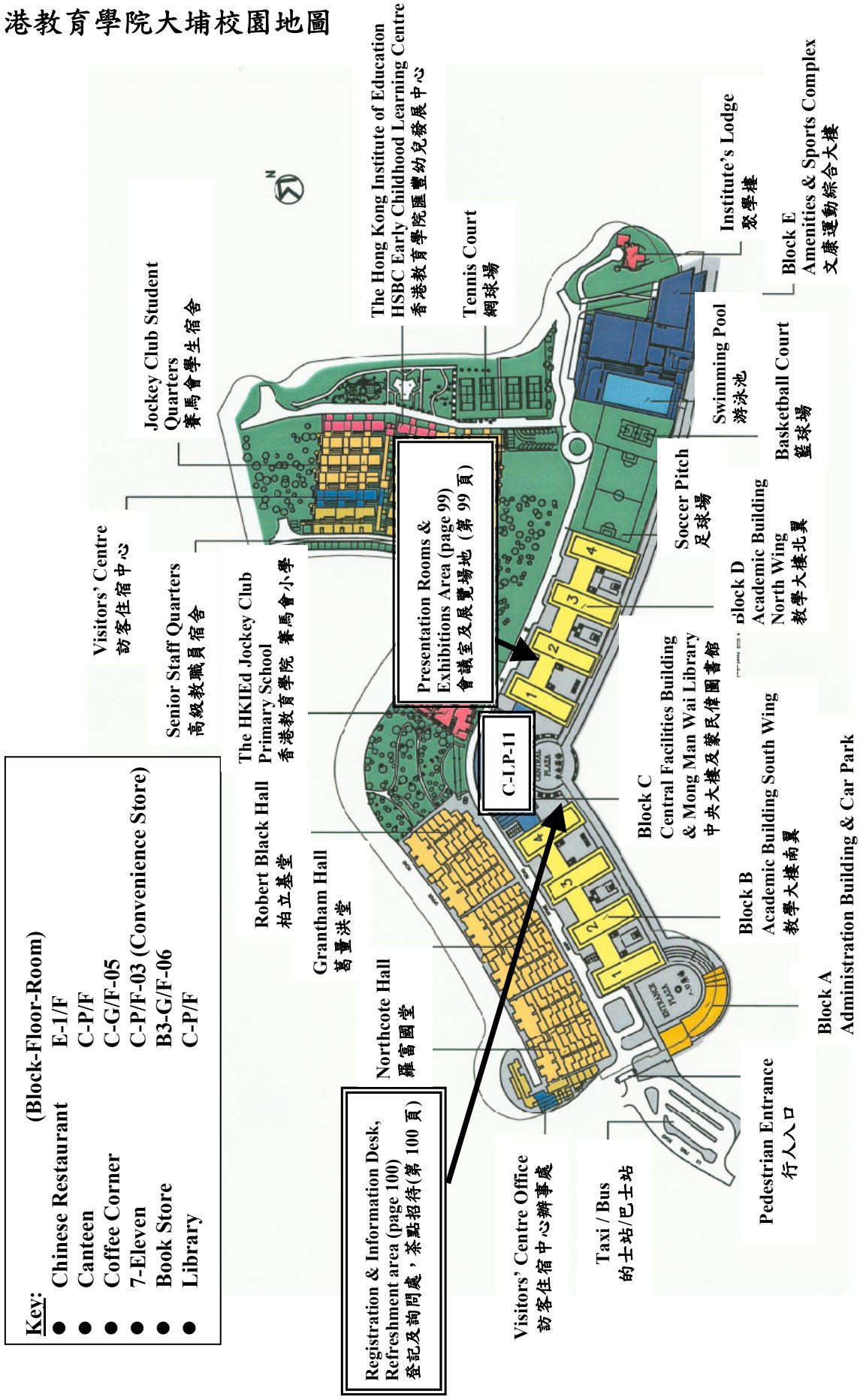
(368) 全球化背景下教育研究範式轉變帶來的挑戰

作者: 張紅霞, 中國

在全球化背景下的社會轉型期，我國教育研究範式正在發生重大轉變。這使得教育研究者面臨著眾多挑戰，其中包括對社會責任與國家需求關係的處理、學術規範與學術傳統矛盾的處理、學術誠信與愛國主義關係的處理、以及東西方人文主義關係的處理，等等。這些錯綜複雜的矛盾體現在整個研究過程中，包括研究課題和研究方法的選擇，研究成果的表述、交流和應用的方式方法等等。這些矛盾的處理，事關我國教育科學研究是否能夠產生出既符合社會需求又具有國際水準成果的重大問題。

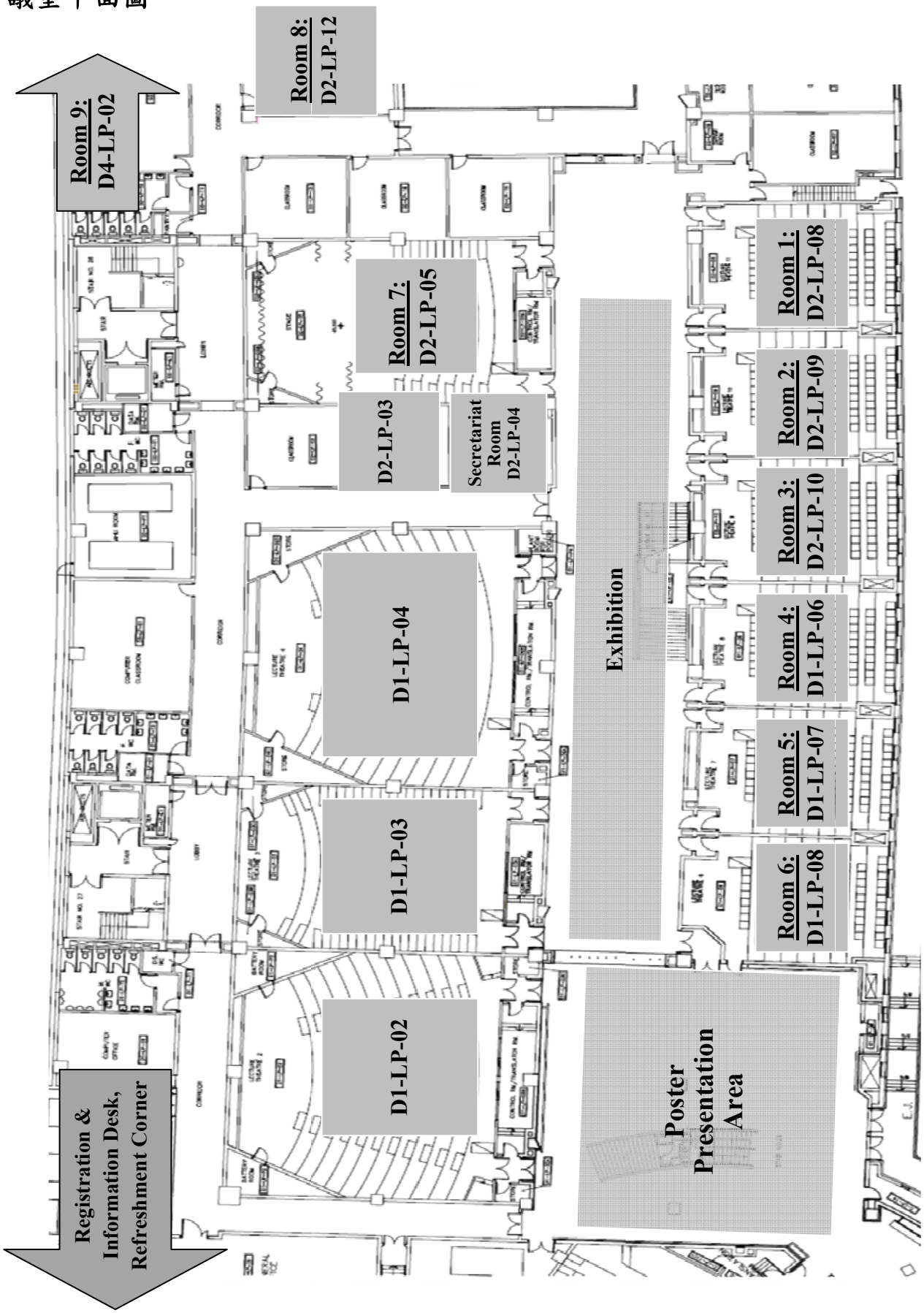
The Hong Kong Institute of Education Tai Po Campus Map

香港教育學院大埔校園地圖

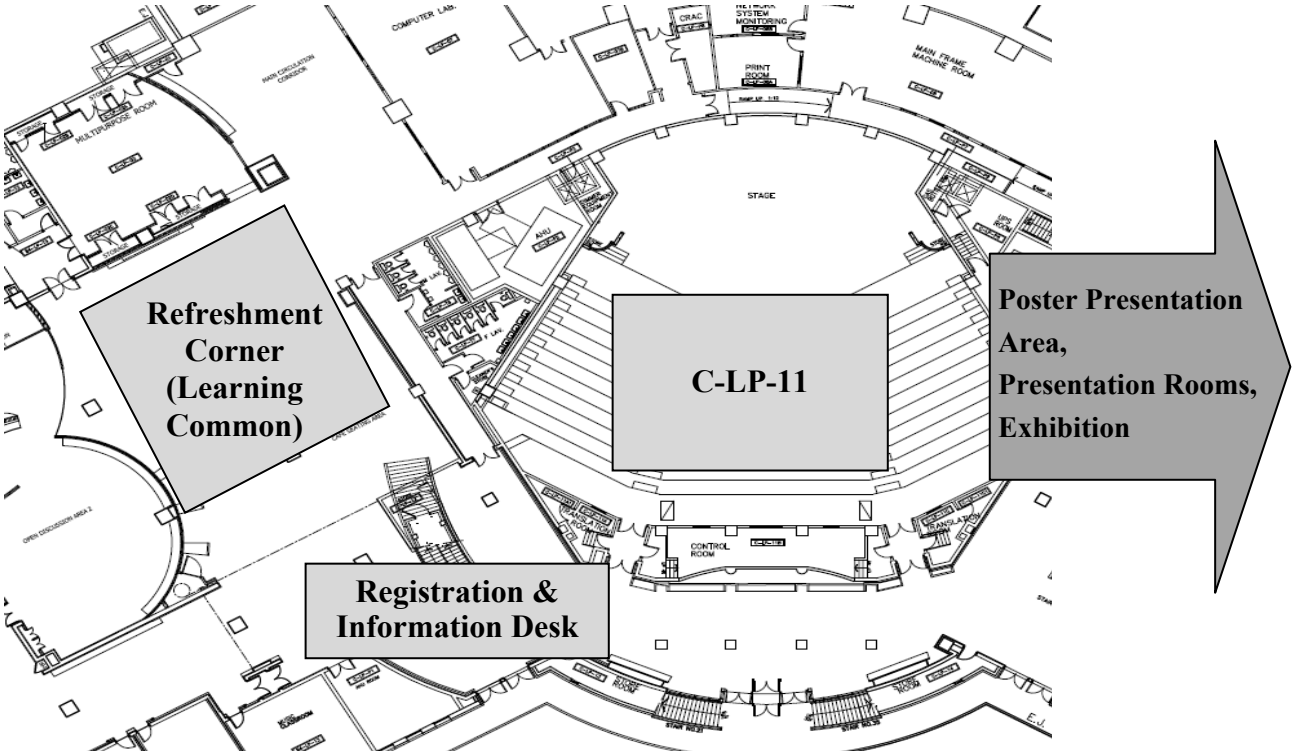


Floor Plan: Paper Presentation Rooms (Block D1-D2)

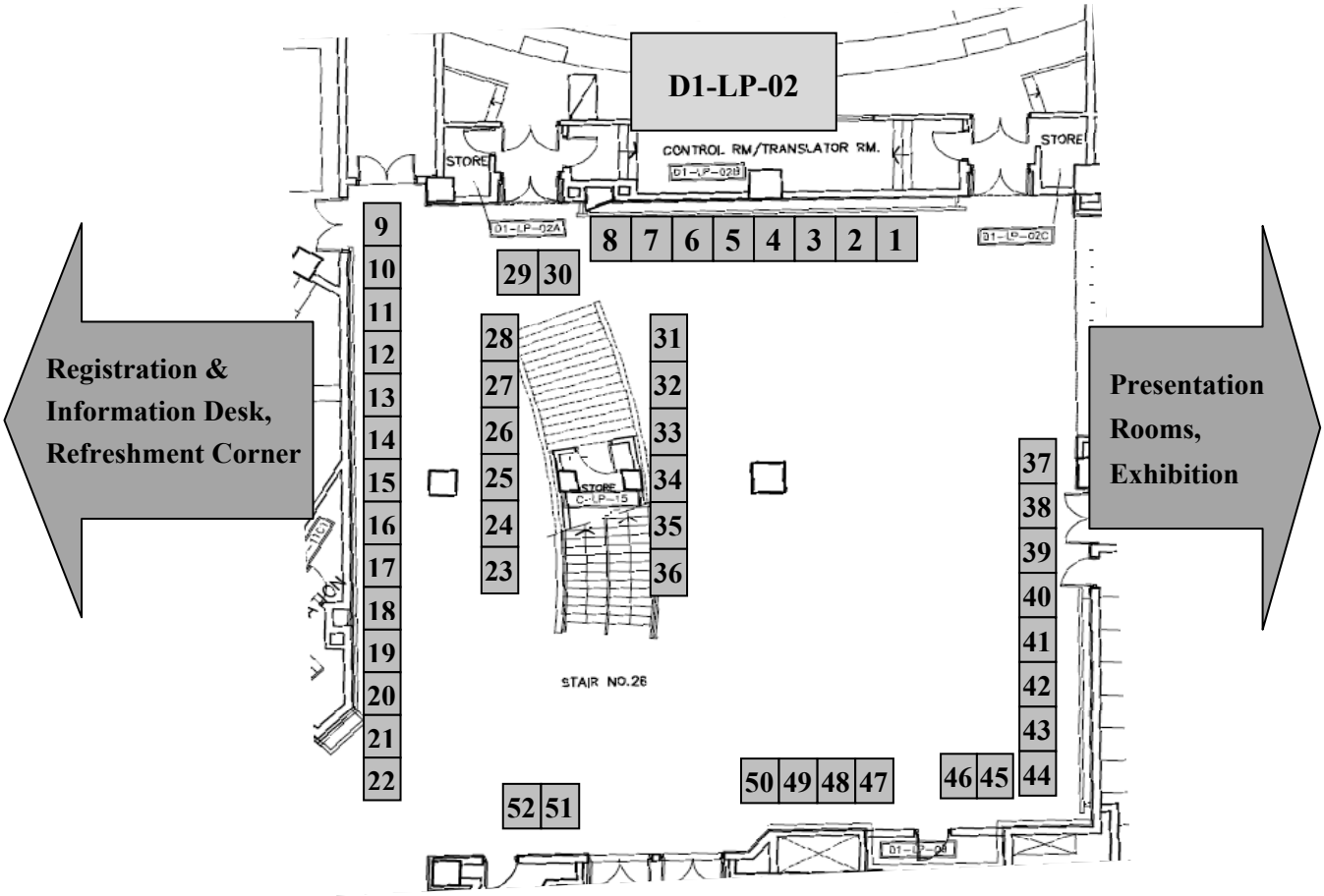
會議室平面圖



Floor Plan: Registration & Information Desk and Refreshment Corner
平面圖：登記及詢問處和茶點招待



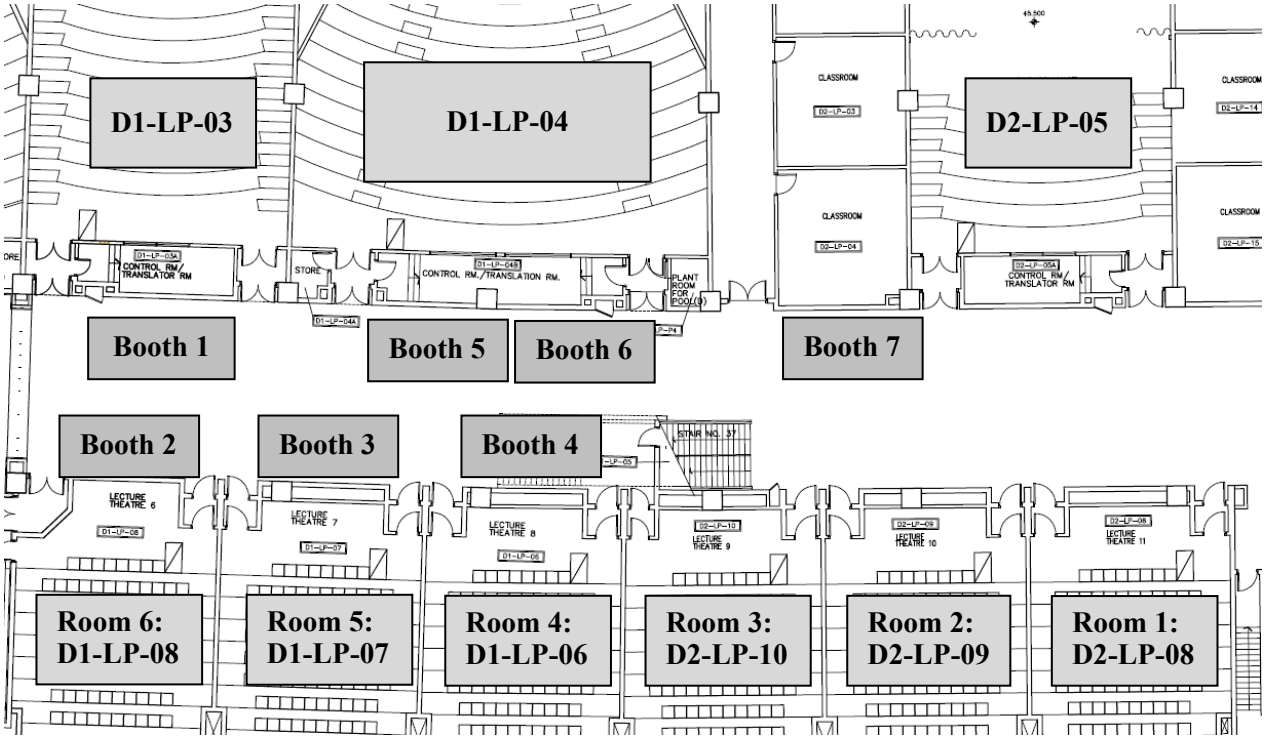
Floor Plan: Poster Presentation Area
平面圖：海報展覽位置



Conference Exhibition List and Booth Location
大會展覽機構及攤位位置

Booth Number	*Organizations*
Booth 1	Kadoorie Farm and Botanic Garden Corporation 嘉道理農場暨植物園公司
Booth 2	National Museum of Marine Biology and Aquarium 台灣國立海洋生物博物館
Booth 3	Association for Geoconservation, Hong Kong 香港地貌岩石保育協會
Booth 4	Education Development Program, The Hong Kong University of Science and Technology
Booth 5	Eco-Education & Resources Centre 生態教育及資源中心
Booth 6	Student Exhibition on Environmental & Geographic Studies
Booth 7	On Wing Tat Co. Ltd

HKIED - Block D1-D2, Lower Podium (LP), Hallway



Reminders and Additional Information

1. Registration & Information Desk and Conference Secretariat Room

- The conference secretariat room is located at room D2-LP-04 (located is shown on Floor plan, page 99).
- The registration & Information Desk is located outside area of room C-LP-11 (location is shown on floor plan, page 100).

Opening Hours:

20 December 2010 (Day 1)	8:30 – 18:00
21 December 2010 (Day 2)	9:00 – 18:00

Conference Secretariat Contact Information:

Ms. ZHANG Jin
Telephone: (852) 2948 6438
Email: gccse@ied.edu.hk

Miss TSOI Ka Wai Vicky
Telephone: (852) 2948 8630
Email: gccse@ied.edu.hk

2. Receipt of the registration fee and conference certificate

- The original receipt of the registration fee will be provided at the Registration & Information Desk together with the conference certificate of attendance.

3. Name Badge

GCCSE 21010 Name Badge will be valid during conference period from 20-21 December 2010. Participants should wear their name badge visible at all times in order to

- attend the speaker session, presentation sessions, workshops and poster sessions.
- access to conference venue.
- take shuttle bus to-and-from the conference venue and University MTR station.
- enjoy campus library service (reading books and using computer in library, but cannot borrow the books out).

4. Lunch Arrangement

- One set lunch per registered participant, per day (20 and 21 December 2010) is covered in the registration fee (except the participants registered as Hong Kong local teachers).
- Lunch is served at HKIED Canteen (The Cove View) - Block C, Podium Floor (C, P/F).
- Each conference participant will receive one set lunch in exchange for a dated lunch box coupon.

5. Conference Banquet Arrangement

- Invited guests, conference registrants and exhibitors are invited to conference banquet at Happiness Cuisine (囍慶盛讌) which is located at Hong Kong Science Park (except the participants registered as students or Hong Kong local teachers).
- Shuttle bus service will be provided for invited guests, conference registrants and exhibitors to the dinner venue from conference venue.
- 4 hours of free parking are available at Hong Kong Science Park (Phase 1 Car Park). Please present your parking ticket to conference secretariat for redeeming complimentary parking.
- You could access to the following weblink for more details:
  Hong Kong Science Park: http://www.hkstp.org/HKSTPC/en_html/en_corporation1_2.jsp

Happiness Cuisine's Address and Telephone

Address: 1/F, Science Park West Avenue, Hong Kong Science Park, Shatin, New Territories, Hong Kong
Telephone: 2845 1028

6. Refreshment

- Refreshment will be served for all invited guests, conference registrants and exhibitors at Learning Common (Location is shown on floor plan, page 100).

7. Transportation

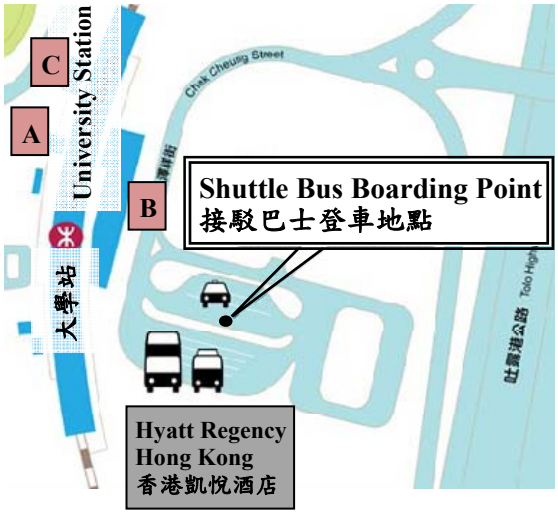
- Shuttle bus service will be provided to invited guests, conference registrants and exhibitors during the conference period.
- Please presenting conference name badge before boarding

Route : To Conference Venue (HKIED)		Boarding Time			
		20 December 2010		21 December 2010	
1	From University MTR Station	8:30am	8:35am	8:30am	8:35am
2	From YWCA (For YWCA residents ONLY)	8:00am	8:05am	8:05am	8:10am

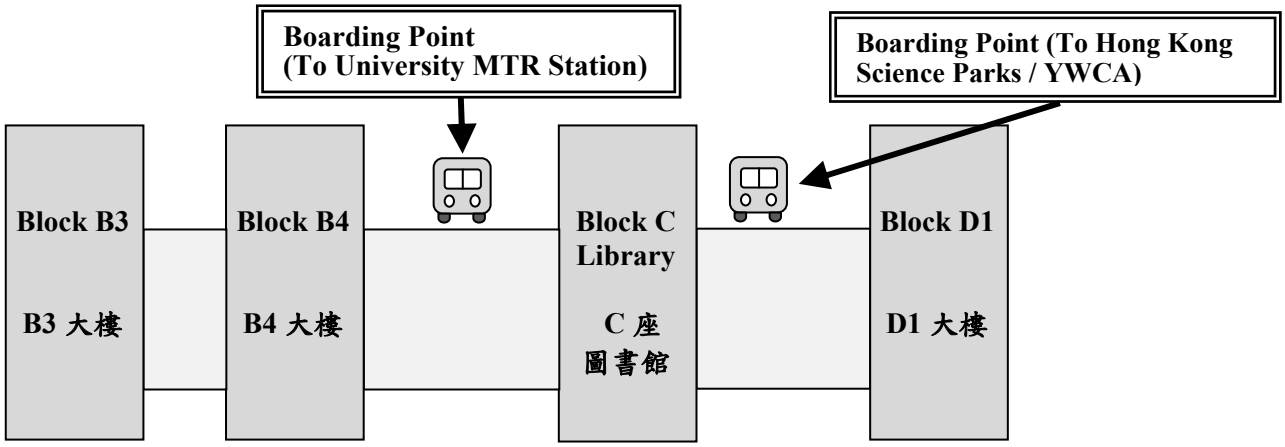
Route: From Conference Venue (HKIED)		Boarding Time			
		20 December 2010		21 December 2010	
1	To University MTR Station	6:10pm	6:20pm	6:00pm	6:10pm
2	To YWCA (For YWCA residents ONLY)	/	/	6:00pm	6:10pm
3	To Hong Kong Science Park (Conference Banquet)	6:15pm	6:15pm	/	/

Route: From Hong Kong Science Park		Boarding Time	
		20 December 2010	
1	To University MTR Station	9:20pm	9:20pm
2	To YWCA (For YWCA residents ONLY)	9:10pm	9:10pm

Boarding Location for Shuttle bus service: From University MTR Station to Conference Venue (HKIED)



Boarding Location for Shuttle Bus Service: From Conference Venue (HKIED) (Ground Floor)



提示及其他資料

1. 登記及詢問處和大會秘書室

- 大會秘書室位於 D2 座 LP-04 室 (請參閱第 99 頁的平面圖)。
- 登記及詢問處位於 C 座 LP-11 室外面 (請參閱第 100 頁的平面圖)。

開放時間：

2010 年 12 月 20 日(首日) 8:30 – 18:00
2010 年 12 月 21 日(次日) 9:00 – 18:00

大議秘書聯絡資料：

張瑾小姐
電話： (852) 2948 6438
電郵： gccse@ied.edu.hk

蔡家慧小姐
電話： (852) 2948 8630
電郵： gccse@ied.edu.hk

2. 註冊費收據和會議証書

- 參加者請在登記及詢問處拿取註冊費收據和會議証書。

3. *名牌*

全球華人科學教育會議 2010 的名牌有效期為 2010 年 12 月 20 至 21 日。在大會期間，參加者必須佩帶名牌，以便：

- 出席和參加嘉賓講座、演講報告、工作坊及海報展覽。
- 進入會議場地。
- 乘坐穿梭巴士進出會議場地及港鐵大學站。
- 享用校園圖書館服務 (在圖書館內閱讀書籍及使用電腦，但不能借書。)

4. 午膳安排

- 大會將向每一位已登記的參加者 (2010 年 12 月 20 及 21 日)每天提供一份午膳 (以香港本地教師身份註冊的參加者除外)。
- 午膳將在香港教育學院食堂 (彥膳坊) 供應。
- 參加者請用大會派發的午膳券換取午膳。

5. 晚宴安排

- 大會晚宴安排在香港科學園 - 囍慶盛讌 (Happiness Cuisine) 招待各位來賓、參加者及參展機構(以學生或香港本地教師身份註冊的參加者除外)。
- 大會將安排接駁巴士，接送各位來賓、參加者及參展機構前往香港科學園 – 囍慶盛讌。
- 會議參加者可享有香港科學園 4 小時免費泊車優惠 (一期停車場)。請向大會秘書出示泊車票以便換取免費泊車優惠。
- 詳細資料，請瀏覽以下網站：
  香港科學園: http://www.hkstp.org/HKSTPC/b5_html/b5_corporation1_2.jsp

囍慶盛讌地址及電話：

地址: 沙田香港科學園科技大道西一樓 ERC Telephone: 2845 1028
電話: 2845 1028

6. 茶點招待

- 大會在 Learning Common (請參閱第 100 頁的平面圖)為參加者、參展機構及來賓提供茶點招待。

7. 交通安排

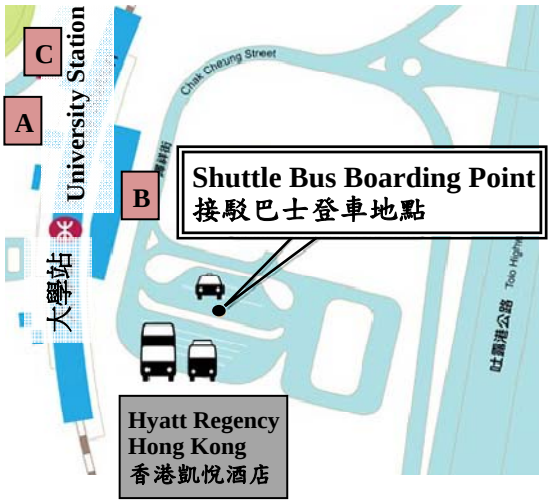
- 在會議期間，大會為招待各位來賓、參加者及參展機構提供接駁巴士服務。
- 登車前請向司機出示大會名牌。

路線：往會議場地（香港教育學院）		登車時間			
		2010 年 12 月 20 日		2010 年 12 月 21 日	
1	由港鐵大學站出發	8:30am	8:35am	8:30am	8:35am
2	由女青柏顏露斯（YWCA）出發（只提供給女青柏顏露斯的住客）	8:00am	8:05am	8:05am	8:10am

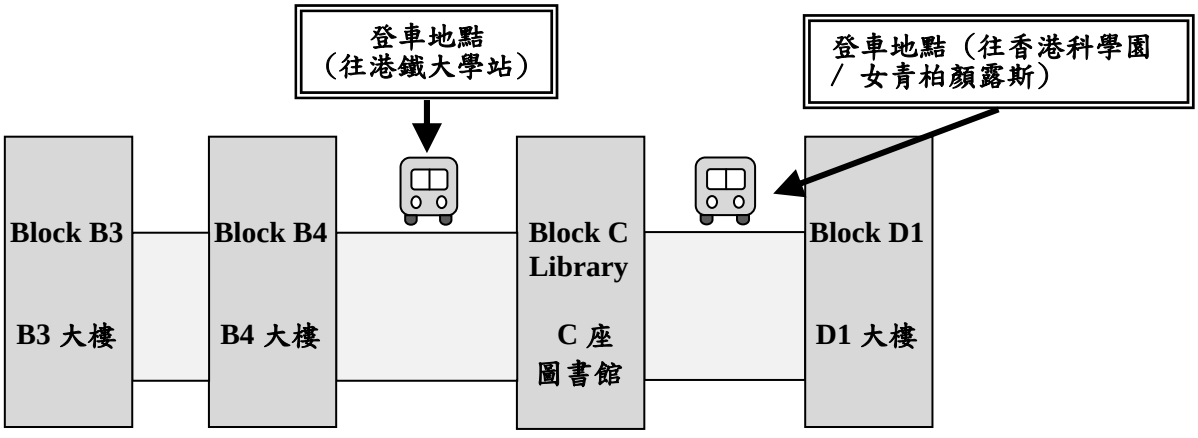
路線：由會議場地（香港教育學院）出發		登車時間			
		2010 年 12 月 20 日		2010 年 12 月 21 日	
1	往港鐵大學站	6:10pm	6:20pm	6:00pm	6:10pm
2	往女青柏顏露斯（YWCA）（只提供給女青柏顏露斯的住客）	/	/	6:00pm	6:10pm
3	往香港科學園 (大會晚宴)	6:15pm	6:15pm	/	/

路線：由香港科學院出發		登車時間	
		2010 年 12 月 20 日	
1	往港鐵大學站	9:20pm	9:20pm
2	往女青柏顏露斯（YWCA）（只提供給女青柏顏露斯的住客）	9:10pm	9:10pm

穿梭巴士登車地點：由港鐵大學站出發往會議場地（香港教育學院）



穿梭巴士登車地點：由會議場地（香港教育學院）出發 (Ground Floor)



Special Thanks
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NOTE

NOTE

Contacts

Name	Telephone/Email	Name	Telephone/Email