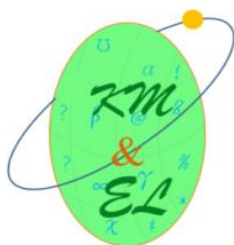# The 10th Workshop of Knowledge Management & E-Learning
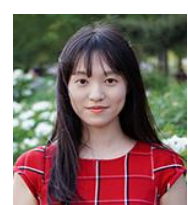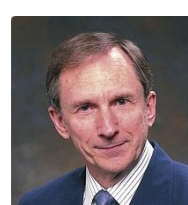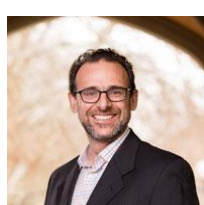
Keynote Seminar Series

Co-organized by

KM&EL Lab, Faculty of Education,

The University of Hong Kong

Beijing Advanced Innovation Center for Future Education,

Beijing Normal University

May – July, 2018

Keynote Seminar Series

Theme: The Future of Online Learning: Challenges, Opportunities, and Creativity

May 15, HKU 1. **Developing and Trialling a Measure of Group Thinking**
Prof. Rupert Wegerif, University of Cambridge, UK

May 23, BNU 2. **Fueling a Cycle for Continuous Improvement in Discussion Based Learning**
Prof. Carolyn Rosé, Carnegie Mellon University, USA

May 24, BNU 3. **Laboratory for Knowledge Management & E-Learning: Review of Ten Years and Prospect of Development**
Minhong (Maggie) Wang, The University of Hong Kong, HK

May 24, BNU 4. **Ensuring Learning Online is not a Second Class University Education**
Prof. Gregor Kennedy, University of Melbourne, Australia

Theme: Big Data for Learning, Communication and Collaboration

July 9, BNU 5. **Healthcare Knowledge Management and E-Learning**
Prof. Doug Vogel, Harbin Institute of Technology, China

July 10, BNU 6. **Network Science in Disaster and Public Health Preparedness**
Prof. Liaquat Hossain & Dr. Shihui Feng, The University of Hong Kong, HK
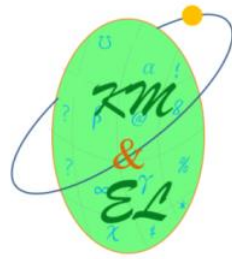
Talk 3

Laboratory for Knowledge Management & E-Learning: Review of 10 Years and Prospect of Development

Minhong (Maggie) Wang

Director, Lab for Knowledge Management & E-Learning, Faculty of Education
The University of Hong Kong

May 24, 2018

香港大学教育学院副教授，博士生导师

知识管理与数位学习实验室主任

东方学者讲座教授， 华东师范大学

北京师范大学未来教育高精尖创新中心访问研究教授

哈佛大学、麻省理工学院、剑桥大学访问学者

Dr WANG, Maggie M.

Personal Particulars

Dr WANG, Maggie M.

王敏红

BA (NJU), MS (NJUPT), PhD (CityUHK)

Associate Professor

Eastern Scholar Chair Professor 東方學者講座教授, **East China Normal University**

Visiting Research Professor, Beijing Advanced Innovation Center for Future Education, Beijing Normal University

Former Visiting Scholar at Harvard University, MIT, and University of Cambridge

Editor-in-Chief, Knowledge Management & E-Learning (indexed in ESCI, Scopus)

Associate Editor, Information & Management (indexed in SSCI, SCI)

Director, Lab for Knowledge Management & E-Learning

Research Interests

- E-Learning Design and Evaluation
- Knowledge Visualization for Deeper Learning
- Problem Solving and Inquiry Learning
- STEM and Medical Education
- Higher Education and Expertise Development
- Knowledge Management
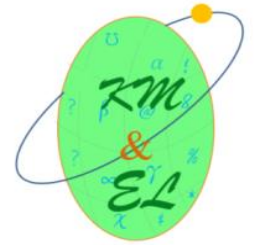- Workplace E-Learning
- Artificial Intelligence

研究领域
  - 学习科学、认知科学、教育技术、知识管理、理科教育、医学教育、人工智能等
研究方向
  - 网上学习系统设计与评估、知识可视化、复杂问题解决与学习、STEM教育、计算机辅助医学诊断与学习、知识管理、绩效评估与企业学习、可视化学习系统设计、基于本体的知识构建、智能Agent技术、

History

Since 2009

- **Lab** for Knowledge Management & E-Learning
  - More than 50 renowned scholars visited the lab and delivered seminars

- **Journal**: *Knowledge Management & E-Learning*
  - Indexed in ESCI and Scopus

- Annual **Workshop** of KM&EL
  - Organized by HKU, in collaboration with BNU and ECNU

  http://kmel-lab.org/website/index.html

Lab for Knowledge Management & E-Learning

Research focus: *Using technology to improve individual and organizational learning & knowledge management for sustainable development*
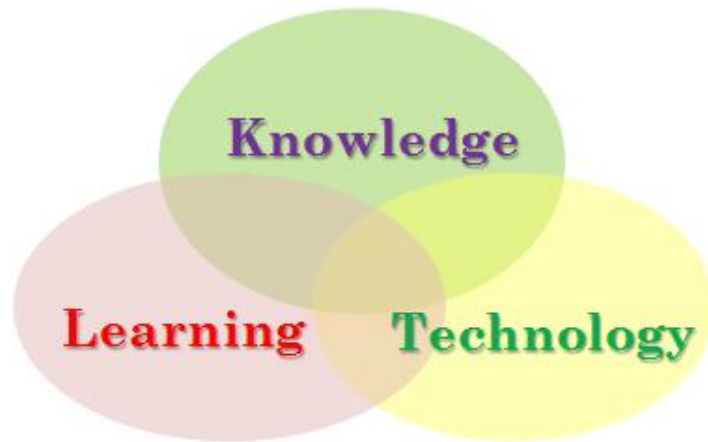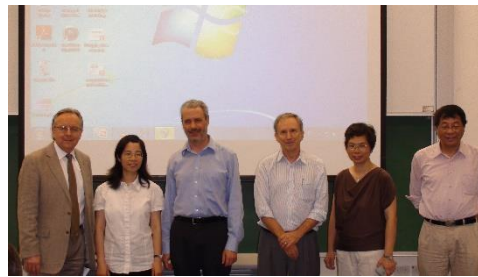

- Knowledge-Practice Gap
- Tacit Knowledge
- Knowledge Visualization
- Complex Problem Solving
- Novice => Expert
- Big Picture of (Evolving) Knowledge

Cross-Disciplinary Collaboration

for creative research

Education

Technology

Business

Social science

Medicine/Healthcare

......
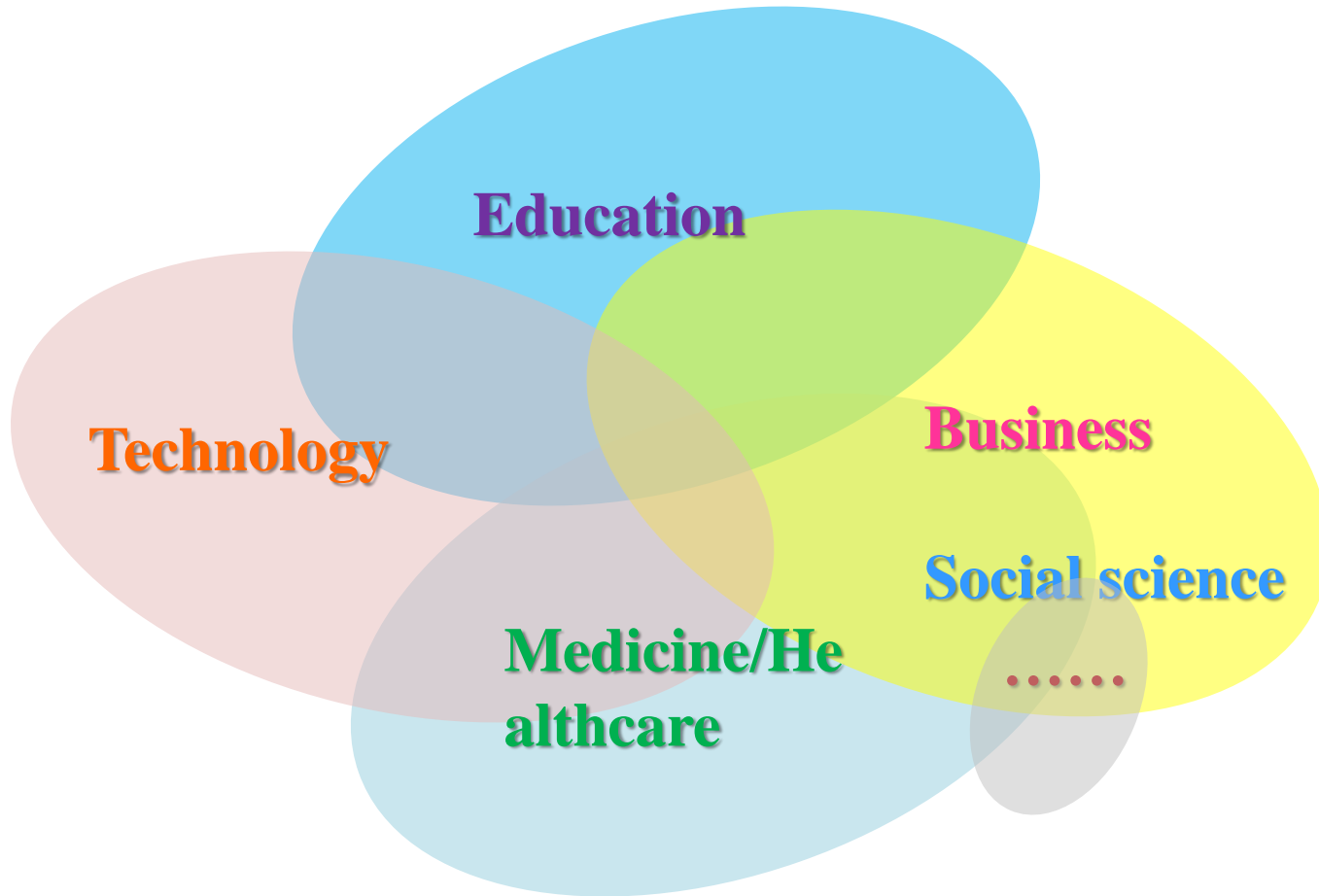
Annual Workshop since 2009

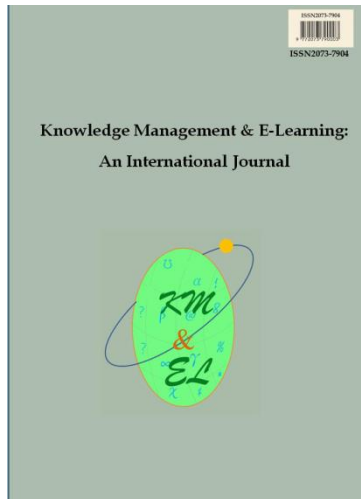An International Journal

Knowledge Management & E-Learning

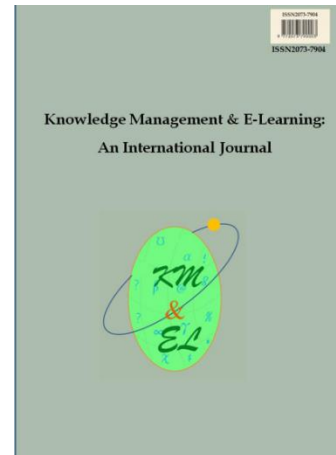**indexed by ESCI (Emerging Sources Citation Index) and Scopus**

As of March 2018
- 37 issues (324 articles) published
- 1,370,019 full-text downloads
- 1,302 citations (in Scopus)
- 129 (40%) articles cited 339 times by 167 articles in SSCI/SCI indexed journals!

http://www.kmel-journal.org/ojs/index.php/online-publication

ISSN 2073-7904

KM&EL Journal

- Free access online journal (4 issues per year)

- A peer reviewed journal

- Publishing studies on
  - Technology-enabled learning and knowledge management in multiple areas including education, business, healthcare/medicine, etc.

- Published 27 special issues (out of a total of 37 issues)

- 129 (40%) articles cited 339 times by 167 articles in SSCI/SCIE indexed journals
  - Including a number of high impact journals,
    e.g., Conservation Letters (IF 7.02), Diabetes Care (IF 11.857), BMJ-British Medical Journal (IF 20.785), Progress in Cardiovascular Diseases (IF=8.177)
    cited by authors from U of Cambridge, Harvard, Deakin & Copenhagen, KwaZulu-Natal, etc.

Articles published in the KM&EL journal are cited by:

SSCI - Education & Educational Research
The Internet and Higher Education(3), IF=4.238
Educational Research Review(5), IF=3.839
Computers & Education(7), IF=3.819
Journal of Research in Science Teaching(9), IF=3.179
Science Education(16), IF=2.506
Academy of Management Learning & Education(18), IF=2.426

SCI - Education, Scientific Disciplines
Academic Medicine(1), IF=5.255
Anatomical Sciences Education(4), IF=3.198
Nurse Education Today(6), IF=2.533

Most frequently cited by
Computers in Human Behavior, IF=3.435—(25)
Computers & Education(7), IF=3.819—(21)
Educational Technology & Society, IF=1.584—(21)

High IF Journals (12090)
BMJ-British Medical Journal(48), IF=20.785
Diabetes Care(168), IF=11.857
Progress in Cardiovascular Diseases(313), IF=8.177
Conservation Letters(398), IF=7.02
Journal of Cleaner Production(608), IF=5.715

Authors of the KM&EL journal

USA
University of California, Berkeley, CA, USA
Columbia University, New York, USA
University of Pennsylvania, Philadelphia, PA, USA
Duke University, USA
Johns Hopkins University, USA
University of Virginia, USA
University of Michigan, USA

Canada
McGill University, Canada
University of British Columbia, Canada

European Union
Imperial College London, UK
University of Warwick, UK
University of Surrey, Guildford, UK
Albert-Ludwigs-University of Freiburg, Germany
University of Copenhagen, Denmark
University of Oslo, Norway
École polytechnique fédérale de Lausanne (EPFL), Switzerland
Karolinska Institutet, Sweden
Uppsala University, Sweden

Asia
The University of Hong Kong, Hong Kong
Peking University, China
Tsinghua University, China
Nanyang Technological University, Singapore

KM&EL Journal Metrics

- ## 2016 CiteScore: 0.70—Ranking
  443/933 in Education, Q2 (top 50%)
  109/161 in Management of Technology and Innovation

- ## 2016 SNIP: 0.752—Ranking
  74/124 in Management of Technology and Innovation
  399/745 in Education

- ## 2016 SJR: 0.302—Ranking
  37/78 in E-Learning, Q2 (top 50%)
  95/159 in Management of Technology and Innovation
  526/954 in Education

- ## Journal Ranking (Google Metrics)—Ranking
  "E-Learning" (H-Index): Top 4
  "knowledge management" (H-Index): Top 9

Global ranking of knowledge management and intellectual capital academic journals: 2017 update

- By Alexander Serenko and Nick Bontis
- Published in the *Journal of Knowledge Management*, 2017, 21(3), p.675-692
- Evaluation of 27 journals in the field
  - Expert survey
  - Citation impact
- The KM&EL journal was ranked No.15

knowledge management, e-learning

Search ▼

SearchWorks Help | Advanced search

Your Search: knowledge ☒ + management, ☒ + e-learning ☒

⫷ Start Over

Limited to: (no limits selected)

« Back to Search Results   1 of 98 | Next >

Knowledge management & e-learning [electronic resource].

"An international journal." Some vols. are also special issues with specific topics.

Language:	English.
Beginning date:	2009
Imprint:	Hong Kong : Laboratory of Knowledge Management & E-Learning, 2009-
Format:	Journal/Periodical
Title Variation:	KM&EL
	Knowledge management and e-learning
Frequency:	Quarterly
Vol/date range:	Began with Vol. 1, no. 1 (Mar. 2009).
Note:	"An international journal." Some vols. are also special issues with specific topics.
Contributor:	University of Hong Kong. Faculty of Education.
Available in anot...	Print version: Knowledge Management & E-Learning 2073-7904
Subjects:	Computer-assisted instruction > Periodicals.
	Knowledge management > Periodicals.
	Educational technology > Periodicals.
	Electronic journals.

16
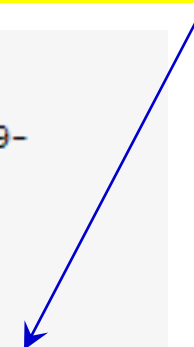
Special Issues (27/37)

- **Applied Knowledge Management in an Institutional Context (Vol 1, No 2)**
- **e-Learning and Knowledge Management in the Early Years (Vol 1, No 4)**
- **Technology Enhanced Learning: Moving Theory into Practice (Vol 2, No 1)**
- **E-Health: Accessing Knowledge for Global Health (Vol 2, No 2)**
- **Advanced Learning and Performance Technologies, Open Contents, and Standards (Vol 2, No 3)**
- **Web-Based Learning: Innovations and Challenges (Vol 2, No 4)**
- **Advances in Health Education: Applying E-Learning, Simulations and Distance Technologies (Vol 3, No 1)**
- **Collaborative Knowledge Management and E-Learning (Vol 3, No 2)**
- **Shifting from Technology-Enhanced Learning to Technology-Transformed Learning (Vol 3, No 3)**
- **Learning, teaching and disseminating knowledge in business process management (Vol 3, No 4)**
- **Advanced learning technologies (Vol 4, No 1)**
- **Supporting, managing, & sustaining creativity and cognition through technology (Vol 4, No 2)**
- **Technology in higher education and human performance (Vol 4, No 3)**
- **Learning, teaching and disseminating knowledge in business process management (Vol 4, No 4)**

Special Issues (27/37)

- **The War for Talent: Technologies and solutions toward competency and skills development and talent identification (Vol 5, No 1)**

- **Technology for higher education, adult learning and human performance (Vol 5, No 3)**

- **Practical applications of KM systems for organizational learning (Vol 5, No 4)**

- **Digital systems supporting cognition and exploratory learning in 21st century (Vol 6, No 2)**

- **Technology in Higher Education, Adult Learning and Professional Development (Vol 6, No 3)**

- **Smart cities of the future: Creating tomorrow's education toward effective skills and career development today (Vol 6, No 4)**

- **Novakian concept mapping in university and professional education (Vol 7, No 1)**

- **Advances in healthcare provider and patient training to improve the quality and safety of patient care (Vol 7, No 3)**

- **eHealth literacy: Emergence of a new concept for creating, evaluating and understanding online health resources for the public (Vol 7, No 4)**

- **Models, technologies and approaches toward widening the open access to learning and education(Vol 8, No 1)**

- **Role of knowledge and learning systems in fostering work-life balance (Vol 8, No 2)**

- **Concept Mapping & Pedagogic Frailty (Vol 9, No 3)**

- **Review and Trend Analysis of Knowledge Management and E-Learning Research (forthcoming)**

The KM&EL journal is included in or recommended by:

1. Directory of Open Access Journals (DOAJ)
https://doaj.org/

2. Royal College of Physicians and Surgeons of Canada
http://rcpsc.medical.org/clip/research/tools_and_resources/journals/index.php
加拿大皇家内科及外科医师学院
Journals for General Education:
Educational Researcher
Knowledge Management and E-Learning: An International Journal
McGill Journal of Education/Revue des sciences de l'éducation de McGill
New Directions for Teaching and Learning

3. USDLA – United States Distance Learning Association
Education Journals (35)
https://www.usdla.org/resources/books-and-articles/

4. NYU Health Sciences Library
Medical Education Resources
http://hslguides.med.nyu.edu/content.php?pid=314207&sid=4228408

Maris Stella College
VIRTUAL LIBRARY
One stop access

http://www.stellavirlib.org/index.htm

Open Educational Resources

"Directory of Open Educational Resources in Pure Sciences, Social Sciences and Management"

OpenCourseWare

Massive Open Online Courses (MOOC)

Directories & Subject Gateways

Thesis

E-books

Organisations / Associations

- Chemistry & Physics

- Mathematics & Computer Science

- Electronics, Botany & Zoology

- Economics & Statistics

- Socialwork

- Management

- Other Organisations

Education

Education Research International
http://www.hindawi.com/journals/edri/
Education Research International is a peer-reviewed, open access journal that publishes original research articles as well as review articles in all areas of education.

American Journal of Educational Research
http://www.sciepub.com/journal/EDUCATION
American Journal of Educational Research is a peer-reviewed, open access journal that provides rapid publication of articles in all areas of educational research

Journal of studies in Education
http://www.macrothink.org/journal/index.php/jse
Journal of Studies in Education is a peer-reviewed online international journal, published by Macrothink Institute. It publishes scholarly articles on the topics related to education, educational administration, educational psychology, economics of education, sociology of education, etc.

Knowledge Management & E-Learning
http://www.kmel-journal.org/ojs/index.php/online-publication/index
Knowledge Management & E-Learning: An International Journal (KM&EL) aims to publish latest and quality research articles in the multidisciplinary area of knowledge management and electronic learning.

The Journal of Academic and Business Ethics (JABE)
http://www.aabri.com/jabe.html
The Journal of Academic and Business Ethics (JABE) publishes original,

Pure Sciences

Mathematics

Chemistry

Physics

Statistics

Computer Science & Information Technology (IT)

English Language & Literature

Management

Management

20

eCAMPUS NEWS

Technology News & Innovation in Higher Education

NEWS

Is higher education heading toward a smart city future?

https://www.ecampusnews.com/technologies/smart-city-universities-855/

BY MERIS STANSBURY, MANAGING EDITOR, @ESN_MERIS
September 18th, 2015

A series of papers around the world researches relationships between innovative universities and tech-based city planning.

According to researchers around the world, there is increasing momentum from some of the world's most innovative universities to align curriculum, research and overall mission to city development that specifically focuses on technology-based systems and services. In other words, progressive higher education is linking itself more than ever to the Internet of Everything.

The research is part of a special edition issue from *Knowledge Management & E-Learning* (KM&EL), which presents nine cases of higher education's alignment to "smart cities of the future," including cities in Italy, India, the U.S., Russia, Japan, Pakistan, Tanzania, South Africa, and Canada.

Smart cities of the future: Creating tomorrow's education toward effective skills and career development today (2014, Vol 6, No 4)

21

Key Features of the journal

- Promoting cross disciplinary research
- Special focus
  - Higher education
  - Medical education
  - Knowledge management
- Acceptance rate: 25%

Editorial Team

Editorial Team

Associate Editors (18)

Patricia A. Abbott (ACMI Fellow; AAN Fellow), University of Michigan, United States
Mark Klein, Massachusetts Institute of Technology, United States
Xun Ge, University of Oklahoma, United States
Andre W. Kushniruk (ACMI Fellow; CAHS Fellow), University of Victoria, Canada
Anders Morch, University of Oslo, Norway
Jiyou Jia, Peking University, China
Jürgen Moormann, Frankfurt School of Finance & Management, Germany
Shengquan Yu, Beijing Normal University, China
Siu Cheung Kong, Hong Kong Institute of Education, Hong Kong
Xiaochun Cheng, Middlesex University, United Kingdom
Jianwei Zhang, State University of New York at Albany, United States
Waltraut Ritter, Knowledge Enterprises, Hong Kong
Murali Raman, Multimedia Univeristy, Malaysia
Rajiv Khosla, La Trobe University, Australia
David Guralnick, Kaleidoscope Learning, New York, United States
Alexandra I. Cristea (BCS Fellow), University of Warwick, United Kingdom
Dickson K.W. Chiu, The University of Hong Kong, Hong Kong
Michael Chau, The University of Hong Kong, Hong Kong

Editorial Team

Lab for Knowledge Management & E-Learning

Research focus: *Using technology to improve individual and organizational learning & knowledge management for sustainable development*

- Knowledge-Practice Gap
- Tacit Knowledge
- Knowledge Visualization
- Complex Problem Solving
- Novice => Expert
- Big Picture of (Evolving) Knowledge

Information /Learning content

Physical Environment (Practices)

Learner

Social Environment (Other people)

Self (reflection, regulation…)

Technology

Advantages: convenience, flexibility, autonomy, opportunities, facilities, …..

What are the challenges to learners?
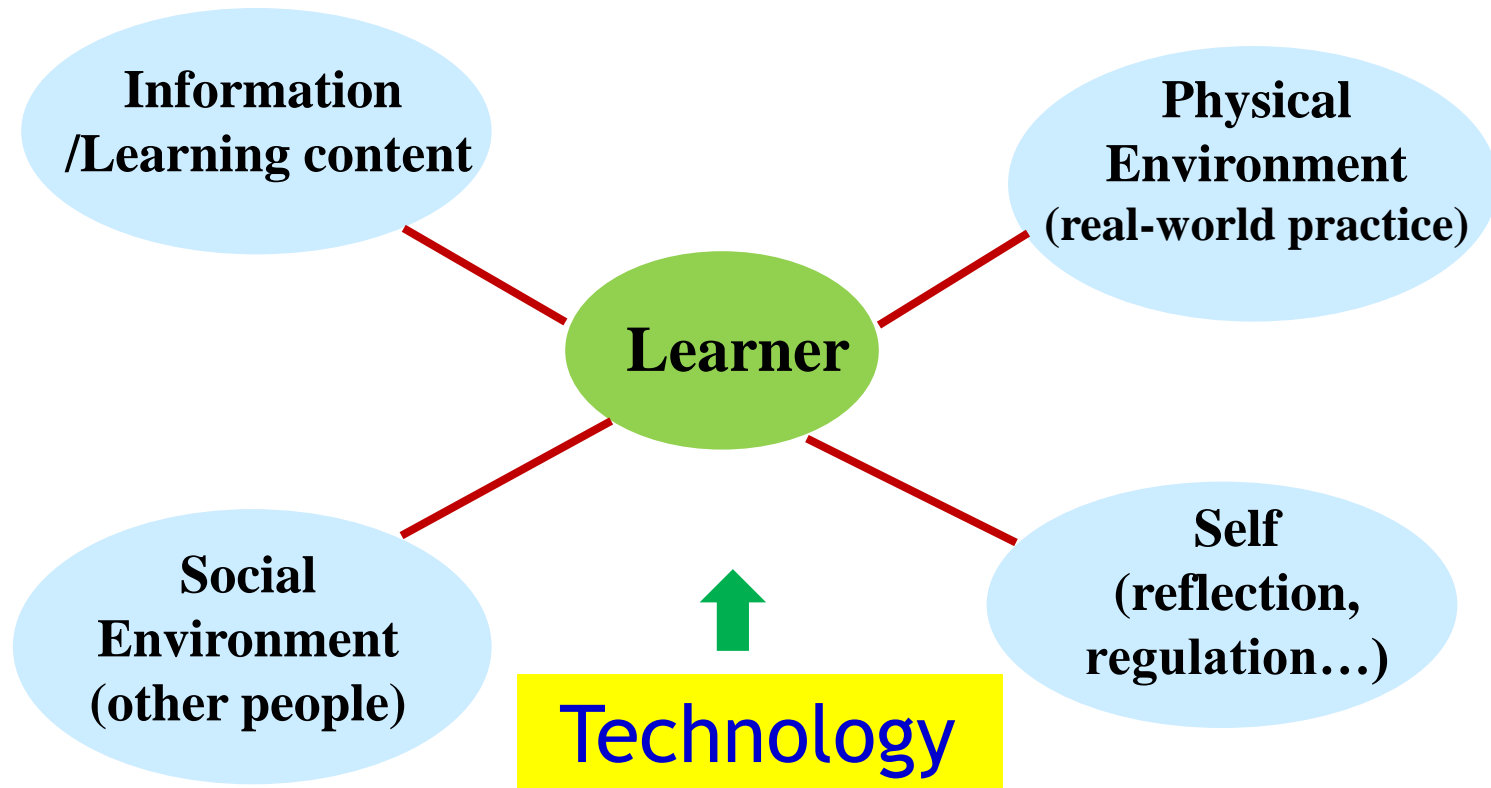
Why should we pay attention to the challenges?

Learning by interaction with real-world practices

- Experiential learning, learning by doing
- Situated learning /contextual learning
- Inquiry-based learning, discovery learning
- Problem-based learning, problem solving
- Project-based learning
- ……

  (close relation to STEM education)

Advantages

- Abstract knowledge ⇔ Real-world practice

- Develop critical thinking and problem solving skills

- Support knowledge construction

- Improve communication and collaboration skills

- Increase motivation

Challenges

- Complex process inaccessible to learners
  - Often ignored by instructors
- Surface learning vs. deeper learning
  - Active in behavior vs. active in thinking
- Undesired learning outcomes
  - Especially in knowledge construction and transfer
- Anxiety, low confidence

Technology can't solve all problems!

Wang, M., Kirschner, P. A., & Bridges, S. M. (2016). Computer-based learning environments for deep learning in inquiry and problem solving contexts. In Proceedings of the 12th International Conference of the Learning Sciences (ICLS). Singapore.

A Workshop at ICLS 2016, Singapore
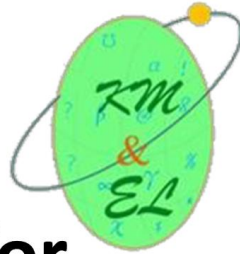
Computer-Based Learning Environments for Deep Learning in Inquiry and Problem-Solving Contexts

Organized by

Minhong (Maggie) Wang, The University of Hong Kong

Paul A. Kirschner, Open University of the Netherlands

Susan M. Bridges, The University of Hong Kong

21 June 2016

Transforming Learning, Empowering Learners

Fostering Deep Learning in Problem-Solving Contexts through Effective Design of Learning Environments with Technology Support

Co-Chairs

Minhong (Maggie) Wang, The University of Hong Kong, Hong Kong
Sharon Derry, University of North Carolina at Chapel Hill, USA
Xun Ge, University of Oklahoma, USA

Discussant

J. Michael Spector, University of North Texas
April 30, 2017

Knowledge to Action: Achieving the Promise of Equal Educational Opportunity

Problem Solving + **Technology-enhanced Learning**

Foster deeper learning

by making the complex process visible and accessible

↑

How to design such learning?

(Learning environment, learning experience/activities, curriculum, etc.)

+

How to analyze such learning?

(more than knowledge score)

Special issues on deeper learning

- Minhong Wang, Sharon Derry, & Xun Ge (Guest Eds.) (2017). Special Issue on Fostering Deep Learning in Problem-Solving Contexts with the Support of Technology. *Educational Technology & Society*. Vol. 20, Issue 4.

  http://www.ifets.info/issues.php?show=current

- Minhong Wang, Paul A. Kirschner, J. Michael Spector, & Xue Ge (Guest Eds.) (in press). Special Issue on Computer-Based Learning Environments for Deeper Learning in Problem Solving Contexts. *Computers in Human Behavior*.

Study 1

Using a Three-Dimensional Thinking Graph to Support Inquiry Learning

Led by Minhong (Maggie) Wang

KM&EL Lab, The University of Hong Kong

in Collaboration with Harvard University

Chris Dede & Tina Grotzer, and their team

Background

- Inquiry learning in a virtual environment
  - Simulating an authentic ecosystem that consists of a number of components interacting in complex ways

- Self-directed, open ended exploration

- Targeting middle school science
  - Part of the ecosystem curriculum

- Purpose of the collaborative project
  - Facilitate complex thinking and reasoning

Learning Goals

- Improving the understanding of ecosystems
  - Ecological processes (photosynthesis 光合作用, respiration 呼吸作用, decomposition 分解作用)
  - Role of producer (e.g., algae 水藻), consumer (e.g., fish 鱼), decomposer (e.g., bacteria 細菌)
  - Food chain & network 食物链，食物网
- Improving the understanding of complex causalities
  - 复杂因果关系
- Improving students' inquiry and collaboration skills

Learning task

To investigate: **Why many fish died overnight**

–   It is built on a scenario of eutrophication (超營養作用) in which fertilizer runoff into the pond leads to an algae (水藻) bloom.

–   Given algae's rapid reproduction rate and very short life cycle, dead algae accumulate in the pond and then decay very quickly. The decay process uses up dissolved oxygen in the water when bacteria decompose dead algae, making the large fish (such as bluegill and largemouth bass) unable to survive.

–   The decomposition of dead algae and dead fish produces additional nutrition to the water, which leads to further algae blooms and subsequent intensive decomposition, using up oxygen in the water and making many fish die.

Date selection

演示demo

学习任务learning task

收集信息collect info

观察数据observe data

小组讨论discussion

百科全书field guide

提交作业submit report

帮助help

信息发布 News and Events

General information:
The pond is connected with a golf course and some residential areas. A new residential project is undergoing development. The pond is in the low-lying areas.

信息1 - 池塘附件新建小区的园艺师：新的住房小区正在开发，我最近每周加班修理小区草坪，希望多施些肥料可以让草坪长得好些。

Daily information on the post board:
The landscaper of the new residential project said "The new housing is under development. I have to work overtime these days to get the lawns in shape by using fertilizer."

池塘附近是一片高尔夫球场，再远处是居民区，并且在建设新的小区。池塘处于地势低洼处。

Data observation

PO4 (mgL)   Green Algae (cells/mL)

40
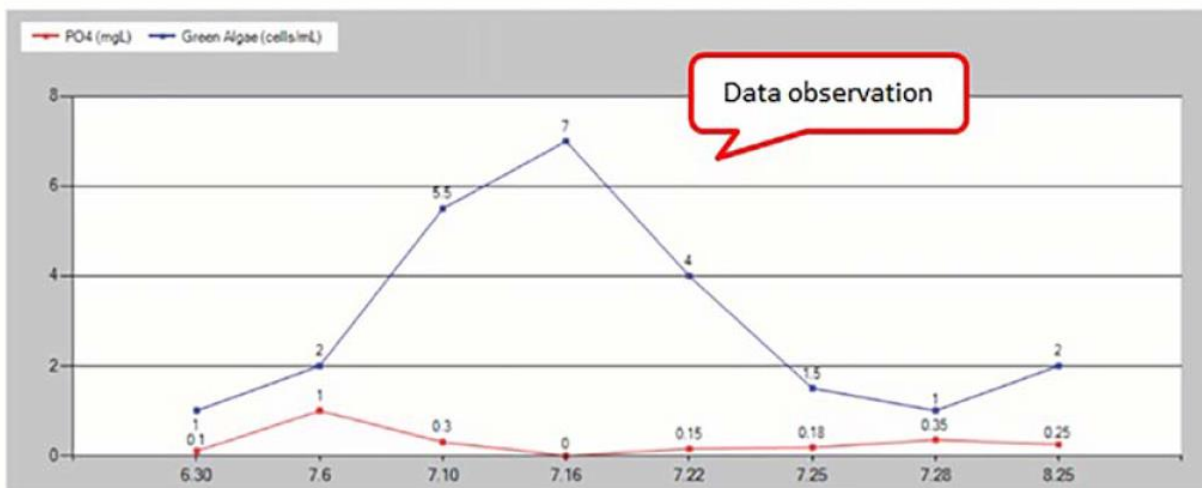
Challenges

- Complex inquiry process
  - Gathering information through observation or experiments
  - Generating hypotheses
  - Reasoning based on the collected information
  - Drawing conclusions

- Intertwined variables
  - Reasoning with multiple components interacting in complex ways - complex causality
    - Bi-directional or cyclic causation, mutual causation 双向因果(互为因果)
    - Change over time, time lags 时间滞后性
    - Non-obvious cause 不可见的原因
    - Domino causality 多米诺因果 (连锁反应)
    - Uncover the primary or root cause

Focus of this project

- Facilitating the complex cognitive process
  - Capturing problem information in multiple aspects
  - Integrating problem information with subject knowledge
  - Reasoning with intertwined variable to generate a solution or explanation
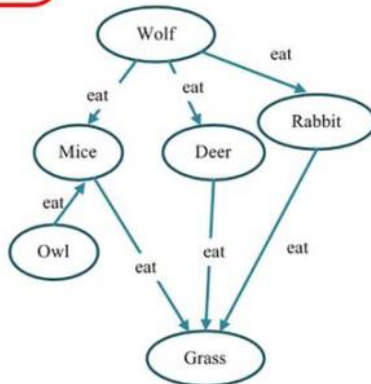- Making the complex thinking and reasoning process visible and accessible

Three dimensional Thinking Graph (3DTG)

Question: Why has the number of wolves on the grassland increased a lot?
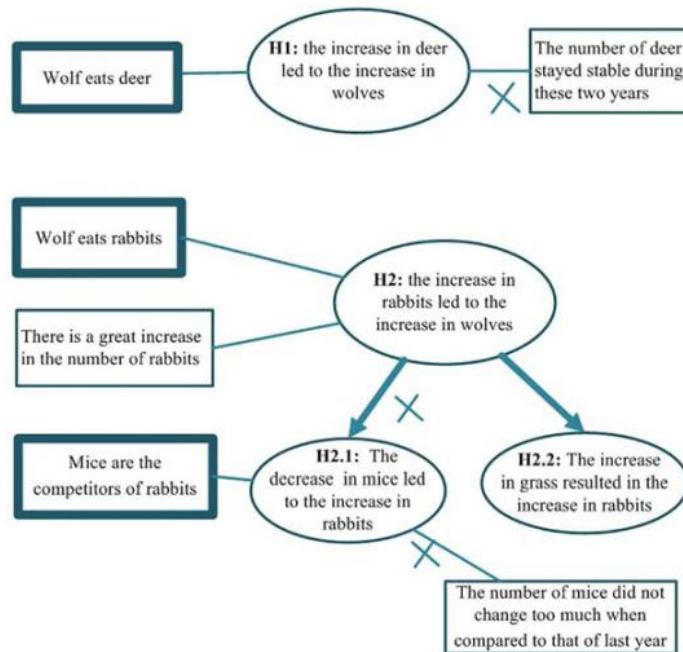
Data Table

Wolf	The number of wolves was stable before last year; but increased a lot in this summer.
Deer	The number of deer has not changed too much these two years.
Mice	The number of mice increased at the end of last year. Its number decreases a little this year and becomes about the same as that of the beginning of last year.
Grass	The grass grew and flourished last summer.

Reasoning Map

Wolf eats deer — H1: the increase in deer led to the increase in wolves — The number of deer stayed stable during these two years ✕

Wolf eats rabbits — H2: the increase in rabbits led to the increase in wolves

There is a great increase in the number of rabbits

Mice are the competitors of rabbits — H2.1: The decrease in mice led to the increase in rabbits — H2.2: The increase in grass resulted in the increase in rabbits

The number of mice did not change too much when compared to that of last year

Concept Map

Wolf — eat → Mice
Wolf — eat → Deer
Wolf — eat → Rabbit
Mice — eat → Owl
Mice — eat → Grass
Owl — eat → Grass
Deer — eat → Grass
Rabbit — eat → Grass

Legend:

Symbol	Meaning
Oval	Hypothesis
Bold rectangle	Knowledge evidence
Down arrow	Deeper reasoning
Thin rectangle	Data evidence
Line	Supporting evidence
Down arrow with ✕	Hypothesis that is rejected
✕	Rejecting evience
Hxxx	Numbering of hypothesis

43
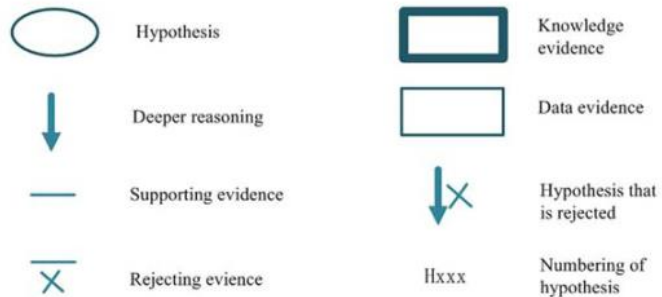
Three dimensional Thinking Graph (3DTG)

- A holistic view for visible and effective thinking
  - Problem information (data table)
  - Subject knowledge (concept map)
  - Hypothetical reasoning process (reasoning map)
- Hypothetical reasoning
  - A logical set of hypotheses
    - Superficial cause => root cause

Research design

- Participants: 97 secondary school students
- Examine the effects of 3DTG vs. concept map
  - Experimental group: using 3DTG
  - Control group: using concept map
- Both groups received the same instruction on inquiry learning and hypothetical reasoning
- Small group learning
    3-4 students in a group

Main findings

- Positive effects of 3DTG in improving:
  - Group inquiry task performance
    - Generating hypotheses
    - Reasoning with data
    - But, not in drawing conclusion
  - Individual Knowledge (test score)

Main findings (cont')

- Student comments
  - Both groups reported difficulties in reasoning and coordinating diverse ideas among group members
  - Experiment group
    - More engaged in high-order thinking and handling multiple hypotheses
    - 3DTG helpful for reasoning globally, reflection throughout the process, and conclusion making
  - Control group
    - More difficulties in hypothesizing
    - Insufficiency of concept map in inquiry

Main findings (cont')

- Experimental group
  - Students of high, medium, low academic levels
    - According to the pre-test score
  - No significant difference among them in the post-knowledge test after the study
  - Students at a low academic level had acquired more knowledge than either high-level or medium-level students.

Related publications

- Juanjuan Chen, Minhong Wang, Tina A. Grotzer, and Chris Dede (in press). Using a three-dimensional thinking graph to support inquiry learning. *Journal of Research in Science Teaching*.

- Juanjuan Chen, Minhong Wang, Chris Dede, and Tina Grotzer (2017). Design of a three-dimensional cognitive mapping approach to support inquiry learning. *Educational Technology & Society*, 20(4), 191-204.

- Minhong Wang, Bo Cheng, Juanjuan Chen, Neil Mercer, and Paul A. Kirschner (2017). The use of web-based collaborative concept mapping to support group learning and interaction in an online environment. *The Internet and Higher Education*, 34, 28–40.

Study 2

Visualizing Thinking in Medical Diagnostic Problem-Solving

Led by Minhong (Maggie) Wang

KM&EL Lab, The University of Hong Kong

Background

- Problem solving in medical education
- Self-directed learning with simulated cases
- Problem solving ⇔ knowledge construction
- Diagnosis of kidney disease was chosen as the learning subject
- Participants: senior year medical students
- Visualization-based learning environment was developed to make the complex process visible for learning

Challenges

- Problem solving
  - How to apply knowledge to solve problems?
  - The process can be complex, placing high cognitive load to learners

- Knowledge construction
  - How to construct knowledge from problem solving?
  - knowledge embedded in problem-solving practice may remain inert and not transferrable to new problems

- Problem solving and knowledge construction are tackled separately, not well integrated.

Dual-mapping cognitive approach
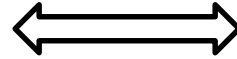
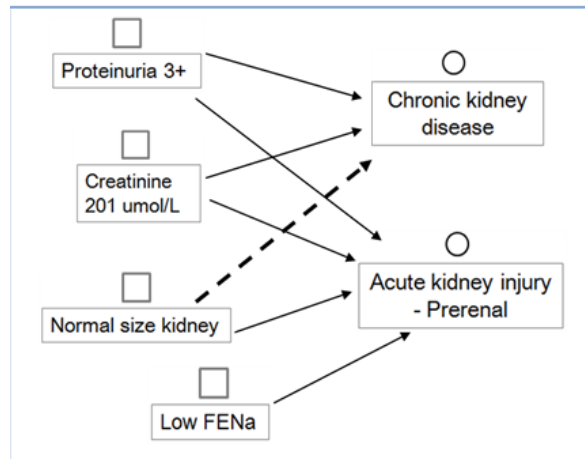**Problem solving** ⟺ **Knowledge construction**

reasoning by generating and testing hypotheses to account for the data

deep understanding of the subject reflected in well-organized knowledge
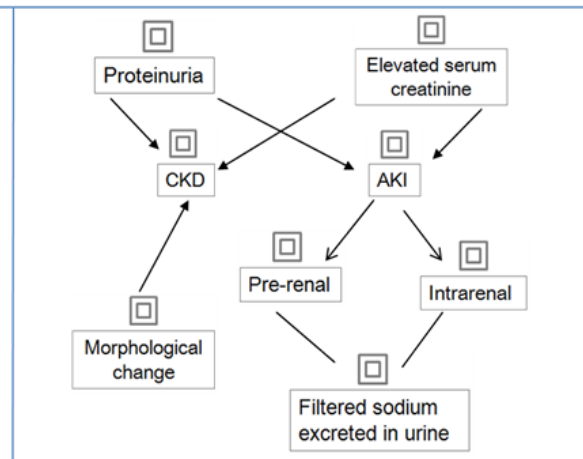
Key elements of cognition

- Critical information
- Formulated hypotheses
- Reasoning for justification

- Key concepts
- Relationships between the concepts

Problem Solving

Proteinuria 3+ → Chronic kidney disease
Creatinine 201 umol/L
Normal size kidney
Low FENa → Acute kidney injury - Prerenal

Knowledge Construction

Proteinuria, Elevated serum creatinine → CKD, AKI
Morphological change
Pre-renal, Intrarenal
Filtered sodium excreted in urine

Computer-based learning environment

- Clinical diagnostic problem-solving

Simulated problem context
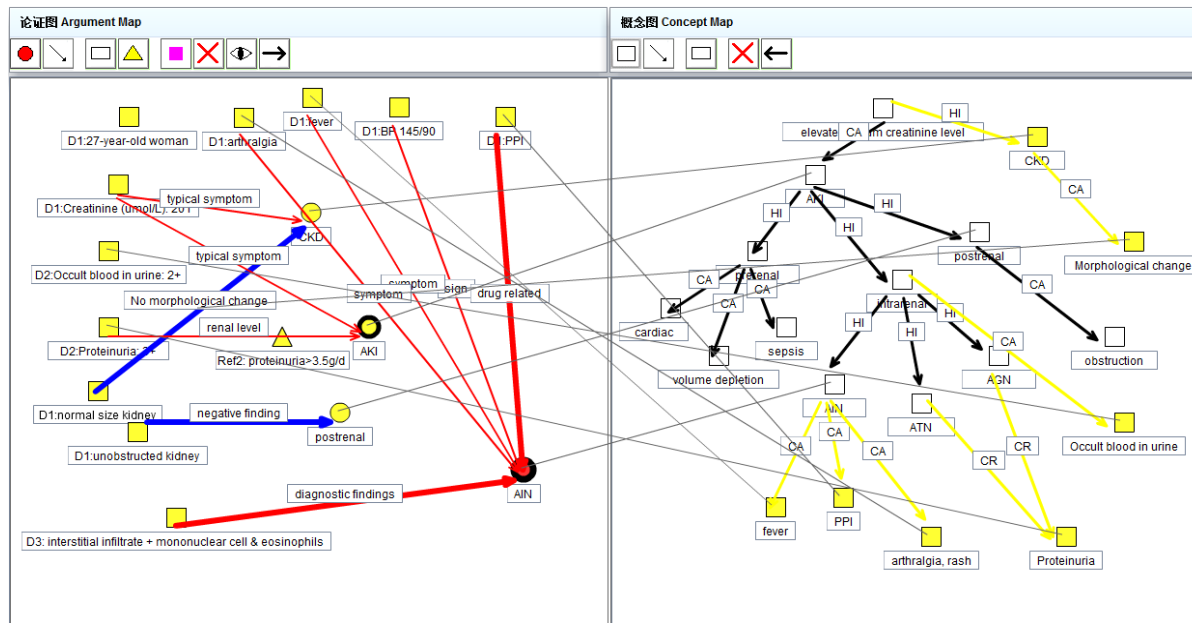
Dual-mapping cognitive tool

Research design

- The clinical tasks and problem-solving contexts were designed in ways similar to realistic clinical encounters
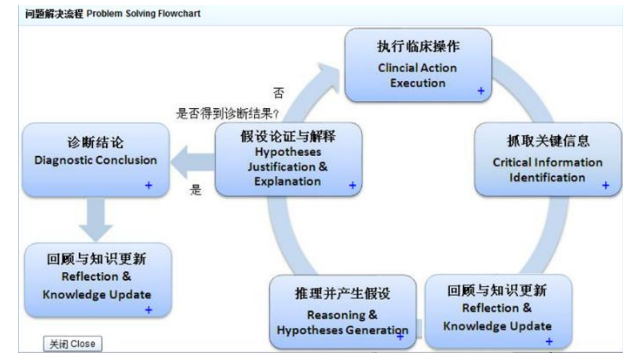 - Learners are given incomplete information of a problem, and need to collect further information by selecting clinical examinations and making intermediate judgments in several rounds before making a diagnostic conclusion.

Research design (cont')

- Examine the effects of cognitive mapping vs. note-taking approaches for effective thinking
  - Both groups received the same instruction on how to capture the <u>key elements</u> of cognition in diagnostic problem solving
    - Data capture
    - Hypotheses formulation
    - Justification by reasoning
    - Diagnostic conclusion
    - Identification of underlying knowledge
  - Experimental group: using cognitive mapping
  - Control group: using note-taking

问题解决流程 Problem Solving Flowchart

执行临床操作
Clincial Action Execution +

抓取关键信息
Critical Information Identification +

诊断结论
Diagnostic Conclusion +

假设论证与解释
Hypotheses Justification & Explanation +

否
是否得到诊断结果?

是

回顾与知识更新
Reflection & Knowledge Update +

推理并产生假设
Reasoning & Hypotheses Generation +

回顾与知识更新
Reflection & Knowledge Update +

关闭 Close

Main findings

- Positive effects of 3DTG on improving:
  - Problem-solving performance
    - Hypotheses formulation
    - Diagnostic conclusion
  - Subject-matter knowledge
    - Reflected in a knowledge test
  - Intrinsic motivation
    - Usefulness
    - Satisfaction/Enjoyment
    - Confidence
- Learning with complex problems can be improved by making complex cognitive processes visible and accessible, e.g., using cognitive mapping tool.

Related publications

- Minhong Wang, Bian Wu, Paul A. Kirschner, & J. Michael Spector (in press). Using cognitive mapping to foster deeper learning with complex problems in a computer-based environment. *Computers in Human Behavior*.

- Bian Wu, Minhong Wang, Tina A. Grotzer, Jun Liu, and Janice M. Johnson (2016). Visualizing complex processes using a cognitive-mapping tool to support the learning of clinical reasoning. *BMC Medical Education*,16: 216.

- Bian Wu, Minhong Wang, Janice M. Johnson, and Tina A. Grotzer (2014). Improving the learning of clinical reasoning through computer-based cognitive representation. *Medical Education Online*, 19, 25940.

- Minhong Wang, Bian Wu, Kinshuk, Nian-Shing Chen, and J. Michael Spector (2013). Connecting problem-solving and knowledge-construction processes in a visualization-based learning environment. *Computers & Education*, 68, 293–306.

- Bian Wu, Minhong Wang, J. Michael Spector, and Stephen J.H. Yang (2013). Design of a dual-mapping learning approach for problem solving and knowledge construction in ill-structured domains. *Educational Technology & Society*, 16(4), 71–84.

Study 3

Visualizing Thinking with Adaptive Feedback in Medical Diagnostic Problem-Solving

Led by Minhong (Maggie) Wang

KM&EL Lab, The University of Hong Kong

Background

- Problem solving in medical education
- Self-directed learning with simulated cases
- Aims to help novices to perform complex diagnostic tasks like an expert (novice => expert)
- Glaucoma diagnosis was chosen as the learning subject
- Participants: senior year medical students
- Visualization-based learning environment was developed to:
  – Making the complex process visible for learning and reflection
  – Providing adaptive feedback to individuals during the process

Challenge

- Complexity of the problem-solving process
  - Implicit – not easy to capture
  - Difficult – not easy to make good performance

- Novice => Expert
  - Enable learners to capture the complex process like an expert

Novice ⇔ expert
gap

- Approach
  - Make the complex process visible for learning and reflection
  - Providing computer-generated, expert knowledge-based adaptive feedback during the task

Problem solving with incomplete information

Reflection with the support of adaptive feedback

⇧

comparison of learner performance and expert performance

Reflection on knowledge underlying multiple cases

$$S_{\text{Tverksy-ratio}}(X, Y) = \frac{f(X \cap Y)}{f(X \cap Y) + \alpha f(X - Y) + \beta f(Y - X)} \quad (\alpha, \beta \geq 0)$$

Research design

- The clinical tasks and problem-solving contexts were designed in ways similar to realistic clinical encounters
  - Learners are given incomplete information of a problem, and need to collect further information by selecting clinical examinations and making intermediate judgments in several rounds before making a diagnostic conclusion.
- Expert knowledge was collected and utilized for generation of adaptive feedback to learners throughout their task process.
  - Experimental group: with expert feedback
  - Control group: without expert feedback
- Both groups completed several cases and were asked to reflect on the knowledge underlying the cases by building a mental map

Learning Outcomes

- Positive effects of computer-generated, expert knowledge-based feedback on improving problem solving performance
  - Clinical examination
  - Intermediate judgement
  - Diagnostic conclusion

- Pre-post improvement for both groups

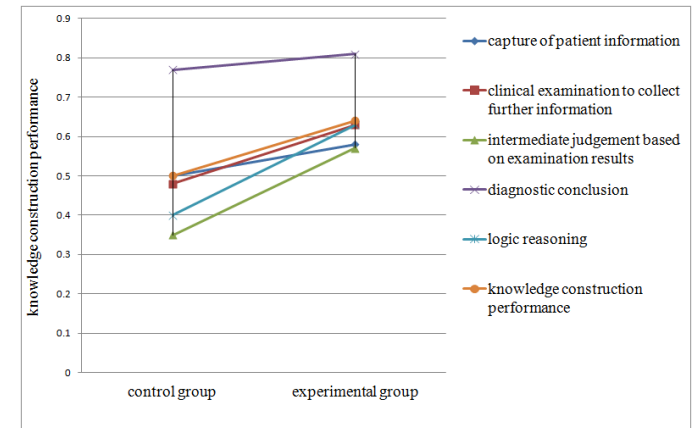- Experimental group outperformed control group
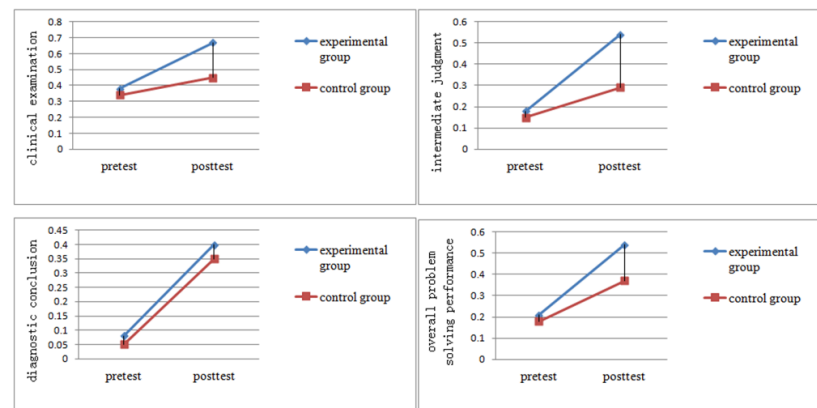
Learning Outcomes (cont')

- Effects on improving knowledge construction

  - Reflected in a mental map

    - Initial information (not significant)

    - Clinical examination (significant)

    - Intermediate judgment (significant)

    - Diagnostic conclusion (not significant)

    - Logical reasoning (significant)

- Positive effects on improving motivation

    - Confidence

    - Satisfaction

Related publications

- Minhong Wang, Bei Yuan, Paul A. Kirschner, Andre W. Kushniruk, and Jun Peng (in press). Reflective learning with complex problems in a visualization-based learning environment with expert support. *Computers in Human Behavior*.

- Bei Yuan, Minhong Wang, Andre W. Kushniruk, and Jun Peng (2017). Deep learning towards expertise development in a visualization-based learning environment. *Educational Technology & Society*, 20(4), 233-246.

- Bei Yuan, Minhong Wang, Andre W. Kushniruk, and Jun Peng (2016). Design of a computer-based learning environment to support diagnostic problem solving towards expertise development. *Knowledge Management & E-Learning*, 8(4), 540–549.

Future/undergoing studies

- Making thinking visible and accessible in inquiry learning
  - Student learning => teacher education
  - In collaboration with Harvard Graduate School of Education
- Visible thinking and group dialogue
  - In collaboration with U of Cambridge (Rupert Wegerif and his team)
- Technology-enhanced training and professional development in healthcare workplaces
  - In collaboration with Harvard Medical School/Massachusetts General Hospital & HKU-Shenzhen Hospital
- Neuroscience related
  - Deeper learning/in-depth thinking as reflected in brain activities, facial expression and emotion, etc.

Deeper learning

- Characterized by a high level of engagement in learning
- Driven by intrinsic motivation
    - More importantly, how to sustain motivation, especially when facing challenges
- Supported by relevant learning approaches or strategies that allow learners to manage complexity and key challenges (most on cognitive aspects) to
    - sustain engagement
    - achieve a high level of understanding and performance.

Minhong Wang, Sharon Derry, and Xun Ge (2017). Guest Editorial: Fostering Deep Learning in Problem Solving Contexts with Technology Support. *Educational Technology & Society, 20*(4), 162-165.

Key issues

- Externalizing the tacit aspects of complex tasks
  - for effective thinking and and improved performance
- Relating new ideas with prior knowledge and experience
  - For effective construction of knowledge
- Combining discrete pieces of knowledge into a coherent whole
- Converging and evolving knowledge in social contexts

**Technology-enhanced environment for deeper learning
Beyond Learning => Knowledge Management**
(knowledge externalization, co-construction, and evolution;
knowledge asset management)

Thank you!

magwang@hku.hk