促進理解的教學-理念與實踐

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促進理解的教學-理念與實踐

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- 科學教育研究的演變
- 有關學生學習研究的進展
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- 有效的學習和教學原理
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- 結語

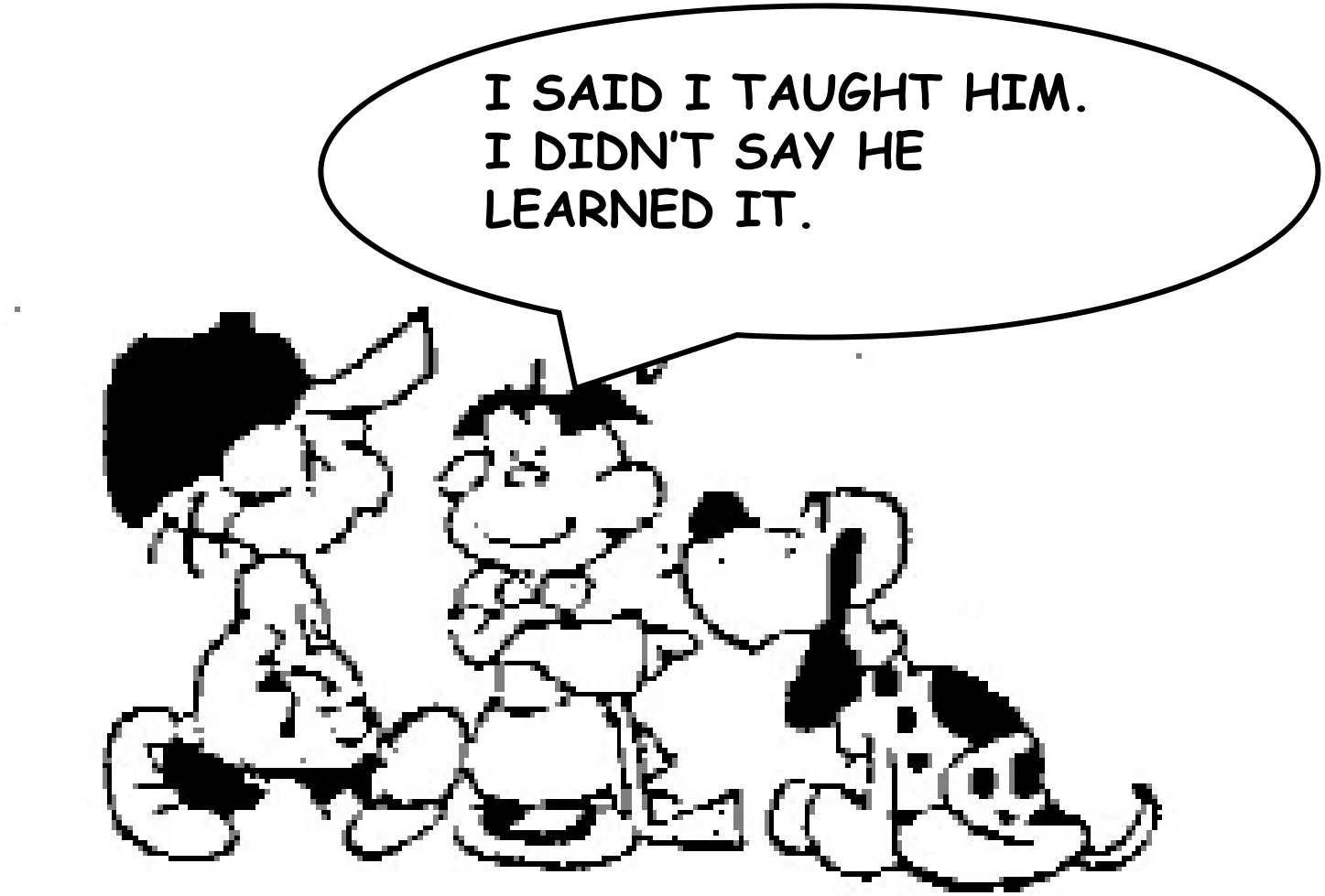
緒言

- 教與學之間有何關聯?
- 教學是科學或藝術？
- 如何建立理念與實踐的連結？
- 如何連結教學的理論與實務？
- 如何達成促進理解的教學?

教與學之間的關聯

Two boys and a dog. One boy is pointing to his dog and saying, “I taught Stripe how to whistle.”

While staring at dog, second boy says,
"I don't hear him whistling."



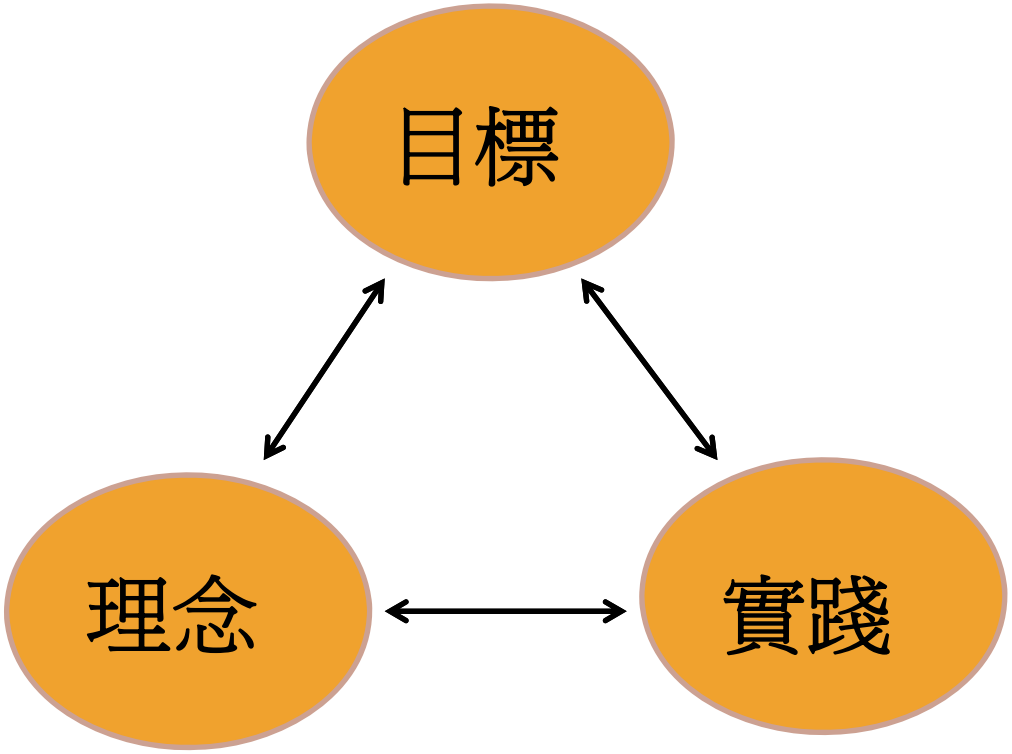
First boy, whilst pointing to dog says,
"I said I taught him, I didn't say he learned

From Checking for Understanding, King Features Syndicate.

教學是科學或藝術？

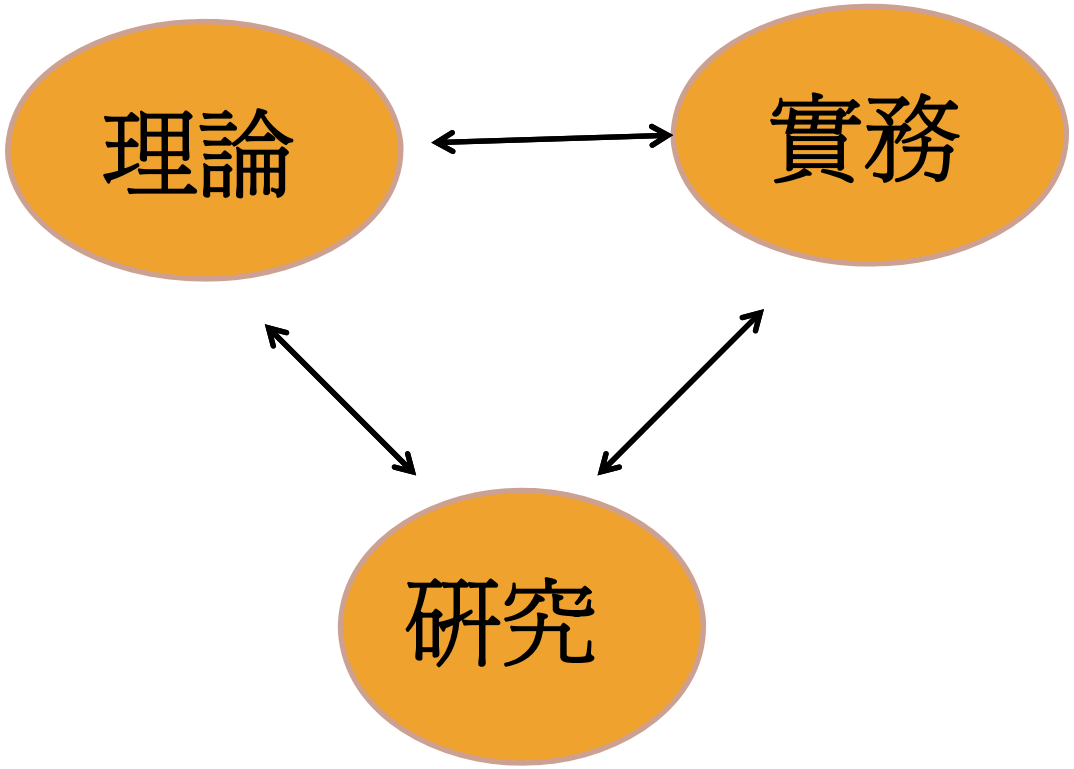
教學活動的最佳表現是達到藝術之境界，但必須以堅實的科學爲基礎。**Gage(1978)**

如何建立理念與實踐的連結？



Plato (left) and Aristotle (right), a detail of *The School of Athens*, a fresco by Raphael. Aristotle gestures to the earth, representing his belief in knowledge through empirical observation and experience, while holding a copy of his *Nicomachean Ethics* in his hand. Plato holds his *Timaeus* and gestures to the heavens, representing his belief in The Forms.

如何連結教學的理論與實務？



科學教育研究的演變

年代	理論基礎	研究設計	研究問題
20-60	rationalist	描述性調查	師生的屬性
	utilitarian	現況報告	成就測驗
		準實驗研究	教學法比較
60-80	empiricist	普遍性比較	行爲目標分類
	behaviorist	相關性研究	個別化教學
		實驗設計	課程評鑑
			教室互動
80-	postpositivist	個案研究	概念發展
	constructivist	自然情境	教學策略

科學教育研究的演變 (續)

研究目的

- 實用導向

  有用、有效、管理

- 學術導向

  行爲改變、學科結構、科學探究、認知發展

- 學生的建構

  意義的掌握、理解、概念改變、
  認知結構、後設認知、合作學習

rationalism 理性思考是知識的主要來源，也是提供行動和信念的唯一正確的基礎

utilitarianism 以有用做爲行動及價值之判準

empiricism 感官的經驗是知識唯一的來源

behaviorism 人或動物客觀而可觀察的行爲是最可靠的心理學數據和探究

positivism 感觀所察覺到的是知識和精確思考的唯一可靠的基礎

postpositivism 後實證主義

constructivism 知識是人在社會情境下對週遭事物的建構

Ausubel, D.(1968). Educational Psychology: A Cognitive View

If I had to reduce all of educational psychology to just one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly.

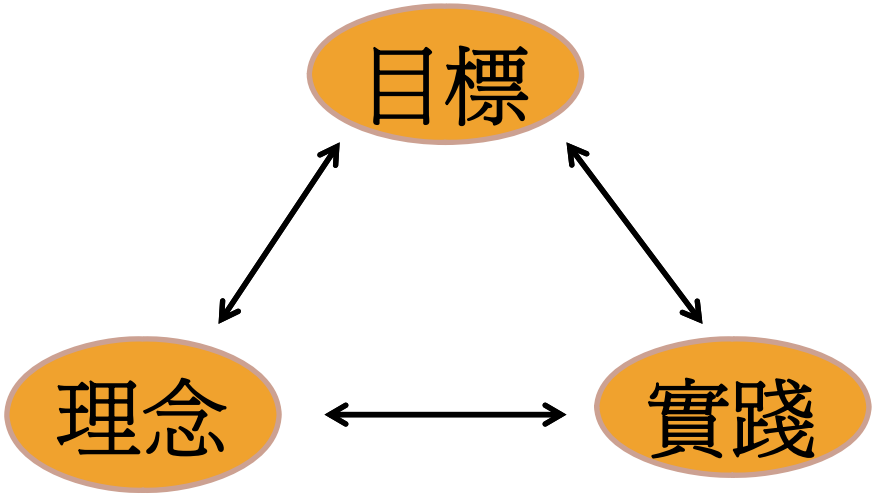
Taber (2009). Progressing Science Education:

Conctruacting the Scientific Research Programme into the Contingent Nature of Learning Science.

If I were asked what is the key idea that the RP (and the wider domain of inquiry) has demonstrated, I think it would simply be that 'what we learn is highly contingent upon a range of influences' and it is this that makes the job of the teacher (and perhaps the science teacher in particular) so challenging. Of course, a key factor is what we already know and understand (but that begs the questions of how we learnt what we already know), and the extent to which it can be used to make sense of new information.

如何達成促進理解的教學?

Meaningful learning
Conceptual change



The most important single factor influencing learning is what the learner already knows.
What we learn is highly contingent upon a range of influences.

Ascertain this and teach him accordingly.
Conceptual change teaching strategies.

有關學生學習研究的進展

- 近數十年來，科學教育的實務、研究和理論，深受科學史、科學哲學、認知心理學、教育社會學、質的研究法、心理計量理論與技術以及網路資訊科技的發展，而有長足的進展(Abell & Lederman, 2007; Fraser, Tobin,& McRobbie, 2012)
- 科學教育學者從不同的觀點和嚴謹的研究方法，突顯我們目前在某一特定領域所擁有的知識，指出未來有待努力的方向，並且說明對政策與實務可能的影響與啓示。

How People Learn : Brain, Mind, Experience, and School

- 有關學習的最新科學研究的特徵之一，是強調以理解爲目標的學習(learning with understanding)，也就是將研究的焦點放在認知的過程。
- 強調可以將人視爲目標導向的行爲者(goal-directed agents)，自己會主動追求資訊。
- 學生進入正式教育體系時，本身已經具備一些先前的知識、技能、信念和概念，學生注意環境的哪方面，如何組織和解讀這些資訊，都深受其影響。這也就影響他們記憶、推理、解決問題和求取新知的能力。
- 近代學習理論的一項基本宗旨是，不同的學習目標，需要不同的教學方法來配合。

- 新的教育目標，需要在學習機會上有所改變。設計學習環境，則與在學習、轉化和能力表現的過程中特別重要的一些議題有關。
- 這些過程深受學習環境是否以學生導向、知識導向、評量導向和社群導向的程度影響。
  - 以學習者爲中心的環境強調有效的教學是從學習者對學習情境所帶來的原有知識開始;這包括文化實踐和信念, 以及對於教材內容的知識。
  - 以知識爲中心的環境所注重的是：思考和解決問題能力需要容易提取和適當加以運用的知識。
  - 支持學習的評量方面強調形成性的評量, 提供機會讓學生修正和改進他們思考和瞭解的品質，以及評量必須和學習目標相互呼應。
  - 以社群爲中心的環境強調學生在家、社區活動中心、和課外的俱樂部的活動，都可對學生的學術成就有重要作用。

Learner-Centered Psychological Principles: A Framework for School Redesign and Reform

http://www.apa.org/ed/lcp2/lcp14.html

Cognitive Factors: Learners…

- Construct meaning from information & experience
- Can create meaningful representations of knowledge when supported over time
- Link new information to existing knowledge
- Can create and apply various critical thinking strategies
- Are influenced by the environment and culture around them

Motivational Factors:

- Are motivated by their interests and beliefs, which in turn influences their learning
- Are motivated by tasks that are novel, challenging and relevant to their lives
- Are more likely to put forth effort to learn when they are motivated

Developmental & Social Factors:

- Should participate in activities that match their developmental needs across the physical, intellectual, social, and emotional domains
- Are influenced by social interactions and relations with others

Individual Differences Factors:

- Have different capabilities from learning influenced by heredity & prior experiences.
- Are most effective when differences in their linguistic and cultural backgrounds are taken into account.
- Should be challenged with high standards and receive feedback through diagnostic, informal and formal methods.

Theory & Research-based Principles of Learning

http://www.cmu.edu/teaching/principles/learning.html

- Students' prior knowledge can help or hinder learning
- How students organize knowledge influences how they learn and apply what they know.
- Students' motivation determines, directs, and sustains what they do to learn.
- To develop mastery, students must acquire component skills, practice integrating them, and know when to apply what they have learned.
- Goal-directed practice coupled with targeted feedback enhances the quality of students' learning.
- Students' current level of development interacts with the social, emotional, and intellectual climate of the course to impact learning.
- To become self-directed learners, students must learn to monitor and adjust their approaches to learning.

Teaching Principles

http://www.cmu.edu/teaching/principles/teaching.html

- Effective teaching involves acquiring relevant knowledge about students and using that knowledge to inform our course design and classroom teaching.
- Effective teaching involves aligning the three major components of instruction: learning objectives, assessments, and instructional activities.
- Effective teaching involves articulating explicit expectations regarding learning objectives and policies.
- Effective teaching involves prioritizing the knowledge and skills we choose to focus on.
- Effective teaching involves recognizing and overcoming our expert blind spots.
- Effective teaching involves adopting appropriate teaching roles to support our learning goals.
- Effective teaching involves progressively refining our courses based on reflection and feedback.

有助學生理解的教學策略

Herr (2008). The Sourcebook for Teaching Science

http://www.csun.edu/science/

- ***The Sourcebook for Teaching Science – Strategies, Activities, and Instructional Resources*, provides new and experienced teachers a wealth of teaching strategies, resources, lessons, activities, and ideas to enhance the teaching and learning of physics, chemistry, biology, and the earth and space sciences.**
- **Resources are based on learning theory, and are designed to stimulate student interest and involvement. As students engage in the activities of this book, they develop higher order reasoning skills, and a deeper understanding of scientific concepts and their relevance to their everyday life.**

Internet Resources http://www.csun.edu/science/

- *I. Developing Scientific Literacy*
- 1 – Building a Scientific Vocabulary
- 2 – Developing Science Reading Skills
- 3 – Developing Science Writing Skills
- 4 – Science, Technology & Society
- *II. Developing Scientific Reasoning*
- 5 – Employing Scientific Methods
- 6 – Developing Scientific Reasoning
- 7 – Thinking Critically & Misconceptions
- *III. Developing Scientific Understanding*
- 8 – Organizing Science Information
- 9 – Graphic Oganizers for Science
- 10 – Learning Science with Analogies
- 11 – Improving Memory in Science
- 12 – Structure and Function in Science
- 13 – Games for Learning Science

- *IV. Developing Scientific Problem Solving*
- 14 - Science Word Problems
- 15 - Geometric Principles in Science
- 16 - Visualizing Problems in Science
- 17 - Dimensional Analysis
- 18 - Stoichiometry
- *V. Developing Scientific Research Skills*
- 19 - Scientific Databases
- 20 - Graphing & Data Analysis
- 21 - Mapping & Visualizing Data
- 22 - Science Inquiry & Research
- 23 - Science Projects & Fairs
- *VI. Resources for Teaching Science*
- 24 - Science Curriculum & Instruction
- 25 - Planning Science Instruction
- 26 - The Science Laboratory
- 27 - Science Reference Information

結語

- 教/學觀點的演變
  - **Personal Constructivist Perspectives**
    - 學生以原有知識主動建構意義
    - 學生的學習受其信念、態度、動機的影響
    - 情境因素對動機和認知的影響
  - **Social Constructivist Perspectives**
    - 語言、社會互動、情境等的影響
    - **ZPD、 scaffolding 、apprenticeship、cultural tools and social practices**

- Adult Learners . . .
  - **Are autonomous and self-directed.**
  - **Have a foundation of life experiences & knowledge.**
  - **Are goal-oriented.**
  - **Are relevancy-oriented.**
  - **Are practical.**
  - **Need to be shown respect.**