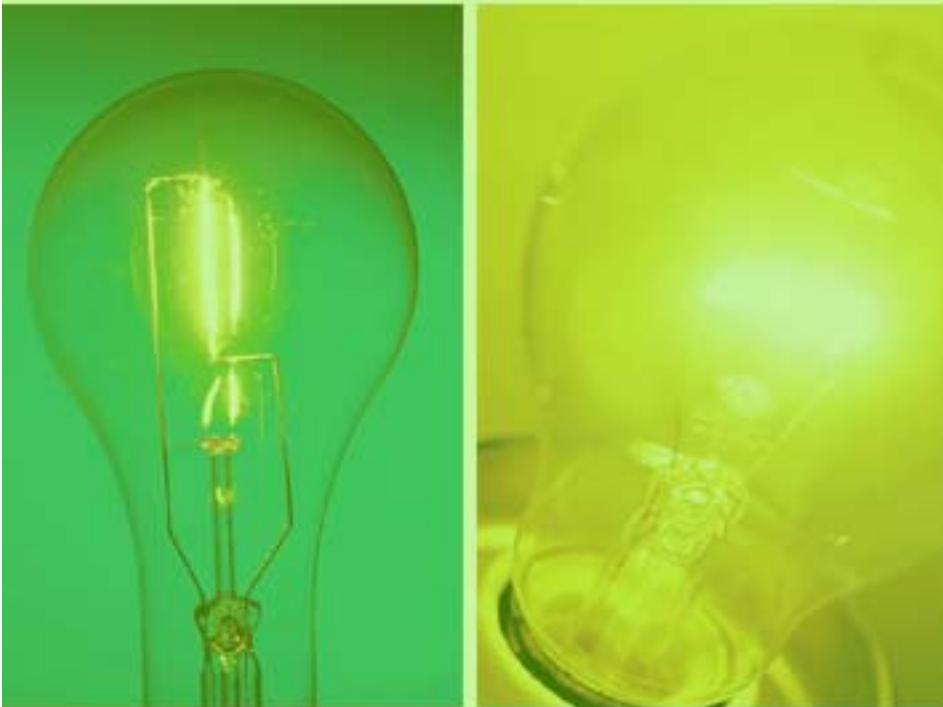


Teaching and Learning in the Contemporary Science Classroom: What We Know and What We Face



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Theoretical \longleftrightarrow Practical


General \longleftrightarrow Specific

What we know \longleftrightarrow What we face



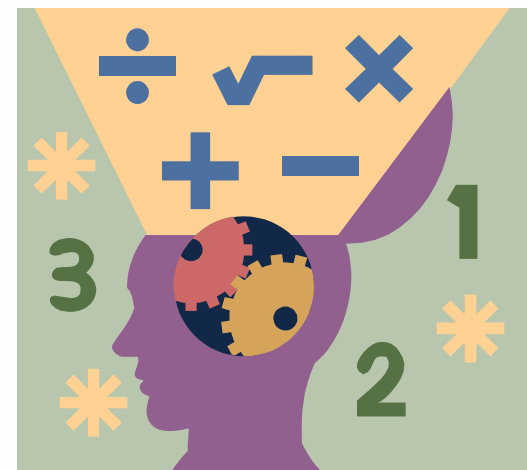
WHAT WE KNOW... *About how we learn*

- Theories of learning involve philosophical and epistemological pursuits:
 - What is knowledge?
 - How do we acquire knowledge? How do we come **to know**?



WHAT WE KNOW... *About how we learn*

- *There is a spectrum* of theories of learning, each that has a specific focus on some influence and/or outcome of the process of learning:
 - Concepts
 - Skills (cognitive, problem solving, process...)
 - Behaviors
 - Language
 - Social interactions
 - Culture
 - Environment
 - Neurological processes





WHAT WE KNOW... *About how we learn*

Using what we know about how we learn:

Designing instruction based on *learning principles*

Learning principles reflect our core beliefs about how people learn and factors that influence the learning process. They are derived from some of the most basic tenets of learning from decades of research on learning and cognition.



WHAT WE KNOW...

Knowledge base principle

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.

--Ausubel, 1968

- Learning is a ***revisionary*** process
 - ***LEARNERS ARE NOT BLANK SLATES***
- They have ***existing understandings***, beliefs, and experiences.
- Prior ideas often are ***tenaciously held***.
- Learning is also a ***generative*** process
 - ***LEARNERS MUST EXPEND MENTAL EFFORT***



WHAT WE KNOW...

Reflection/metacognition principle

Reflection and metacognition influence learning in as much as they require monitoring one's progress in the process of learning, and responding to feedback by regulating one's strategies for learning.

- Reflection entails:
 - examining what one is learning
 - considering alternatives
 - Improving and refining understanding
- Metacognition consists of:
 - monitoring one's progress
 - responding to feedback



WHAT WE KNOW...

Motivation principle

Motivational constructs such as goals, values, self-efficacy, and control beliefs play a significant mediation role in the process of learning.

- Students' motivational beliefs about:
 - themselves as learners
 - the roles of individuals in a classroom learning community
- Motivation to change a conception
- Interest in nanoscience



WHAT WE KNOW...

Development principle

The growth of knowledge is a progressive construction and revision of cognitive structures, abilities, and processes.

- Learning takes place in **stages**
- There is a development of general, logical thinking skills



WHAT WE KNOW...

Social context principle

While learning is an individual activity, it is also a socially situated process in which learners interact with other members of a community.

- Social interaction is as much a part of the process of learning as the individual expenditure of mental effort.
- Learning “is always bound up with, co-dependent with, the participation and activity of Others, be they persons, tools, symbols, processes, or things.” (Lemke, 1997, p. 38).



WHAT WE FACE...

Minds of Our Own



WHAT WE FACE... Designing Instruction

Instructor needs to identify:

- What it is that you want Ss to learn?
(concept)
- How will you know that Ss have learned?
(assessment)
- **What experiences will facilitate Ss' learning of what you want them to learn? (learning experience)**
 - **Activity versus lesson**



WHAT WE FACE... Designing Instruction

- **Recognize that learning is not simply additive in nature. It is also *revisionary and generative*.**
 - The learner must make sense of what is to be learned.
 - You cannot change someone's conceptions.
 - You can have considerable influence on their motivation.
 - You can provide the environment and experiences.
 - *Use of evidence*
 - » To create conceptual conflict, disequilibrium
 - » To confirm, reinforce accuracy



WHAT WE FACE... Designing Instruction

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

--David Ausubel, 1968

- Take into account that learners have prior knowledge.
 - Common predominant misconceptions exist.
 - Find out what common misconceptions are.
 - Students' conceptions makes sense to some degree.
 - Find **how/why** they may make sense to those who hold them.



WHAT WE FACE... Designing Instruction

- **Provide opportunities that allow students to make their ideas explicit.**
 - Students need to know what their ideas are.
 - Knowing what they know **AND** knowing what they don't know
 - Interact, question, elicit responses
 - Allow *students* opportunities to *explain*.
 - Creating an accurate response is very different from recognizing an accurate response!



WHAT WE FACE... Mediators

- A few “contemporary classroom” mediators in the process of designing instruction
 - Standards
 - Textbooks
 - Standardized tests
 - Time

WHAT WE FACE... Standards

- Standards

- National Standards
- National Benchmarks
- State Academic Standards



- Indiana: <http://www.doe.state.in.us/standards/HS-Science.html>
 - “Indiana Academic Standards describe what Indiana students should know and be able to do. They are clear, concise, jargon-free, and second to none. These standards are more rigorous and provide clearer support and direction for curriculum and instructional choices at the local level.”
- Michigan: http://www.michigan.gov/mde/0,1607,7-140-38924_41644_42814---,00.html
- Illinois: <http://intranet.cps.k12.il.us/Standards/>



WHAT WE FACE... Textbooks

- Textbooks tend to drive curriculum planning and instruction.
- Where does “nano” fit into existing, discipline-specific science courses?
 - Quantum Dots
 - Topic(s)
 - Concepts or key ideas would you teach
 - Challenges, issues, questions



WHAT WE FACE...Standardized Tests

- **Standardized tests:**
 - Dan and Karen placed equal amounts of different kinds of fruit on a sidewalk to investigate which fruit would be visited by more ants during one hour. The table below shows their results.

Type of Fruit	Number of Ants
Apple	8
Banana	17
Orange	5
Strawberry	12

- Use the information in the table to construct a BAR GRAPH.



WHAT WE FACE... Time

- When do I have time to
 - teach this in my curriculum?
 - “My curriculum is already crowded...”
 - develop a new lesson?
 - “I teach three different classes...”
 - learn the science myself?

WHAT WE FACE... Designing Instruction for NCLT Professional Development

*A word about
connectedness*

