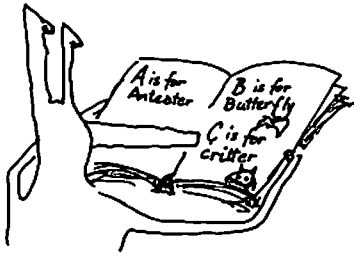


MPS 12: Learning



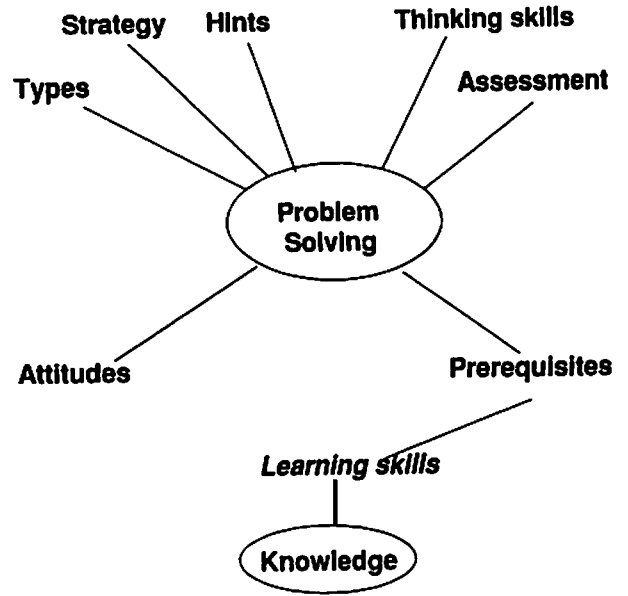
Def: Acquiring new skills, attitudes or knowledge.

WHY IMPORTANT?

1. Survive formal education.
2. Develop lifetime learning skills.
3. Provide knowledge in a form needed for problem solving.
4. Learn with and from others.
5. Prepare for small group, self-directed, self-assessed, interdependent problem-based learning.

MPS 12: Learning

Where it fits in....



MPS 12: Learning Pretest, objectives

Pretest: Use an "x" to rate your Awareness & Skill

Time 10 s Finish by _____

**Objectives...
Read over...**

Time _____ Finish by _____

MPS 12: Learning Route ahead

Address issues based on Research about learning:

Attitude: motivated & expect success

Time on task: be organized

Be active

Cooperate

Quality of interaction

[Prompt feedback]

Exploit personal style

Exploit teacher's learning environment

Improve retention

Knowledge: structure, elaborate, cues

MPS 12: Learning . Research says:

Learning improves if students (learners) are:

1. Motivated.
2. In an environment that expects *Success*.
- 3 Clear for time and task
4. Actively engaged in the learning (not passively listening/reading).
5. Working cooperatively together (not competitively).
6. Experiencing quality interaction with instructor inside & outside of class. High social environment.
7. Receive prompt feedback.
8. In an environment that caters to the learner's personal learning style.

5

MPS 12: Learning: Ideas:

Write reflections _____

6

MPS 12: Learning 1. Be motivated & 2. Expect success. Research says... expect success

Visualize yourself in control:

who is in charge of your learning?

You? the Prof? the University?

Set *your* learning goals

Reward yourself

Activity: Be proactive

as an individual
list opportunities for motivation & to show that you expect success.

TIME _____ min

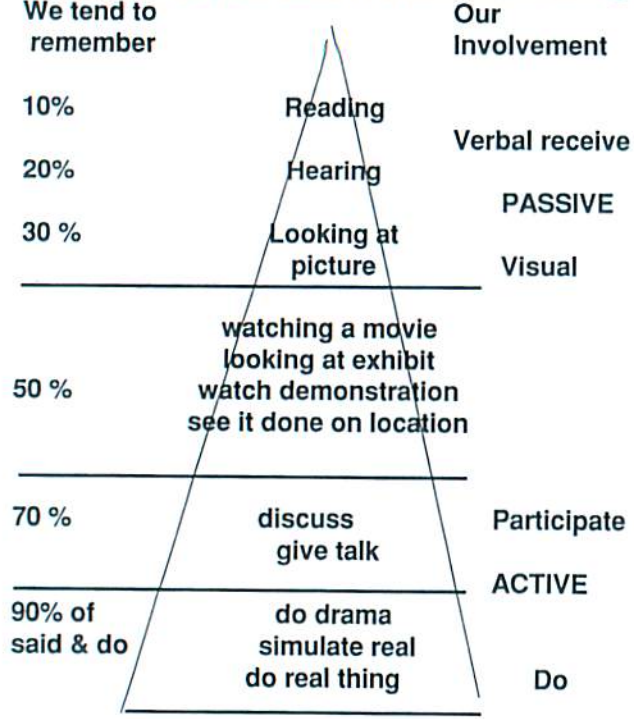
5A

**MPS 12: Learning 3. Clear time on task
Research says... have clear time on task
Related to motivation &
to time management MPS 17:**

Have clear idea of what task you are going to do, the resources you will use and then do it!

7

MPS 12: Learning **3. Be Active**
Research says... Dale's Cone of learning



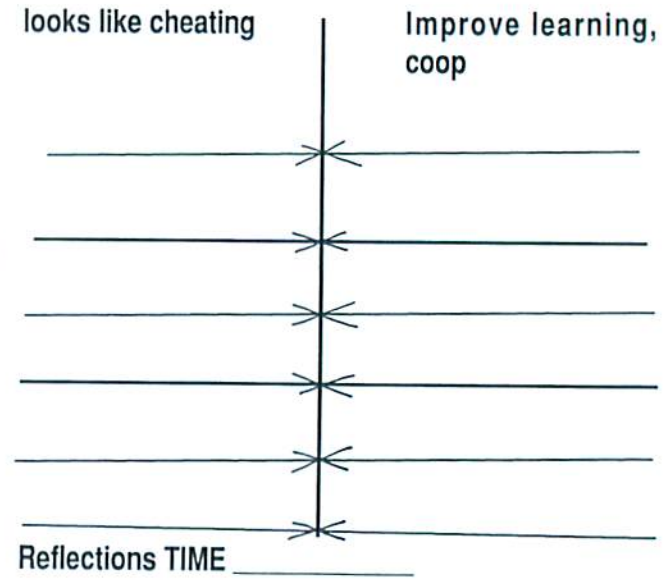
MPS 12: Learning
Research says... Be an active learner
 To some extent, the prof "owns" much of the learning environment. If the Professor elects to lecture, then it may be hard to be active. But is it? What does "be active mean" for your learning?

Activity
 Form groups of _____ or individual
 share ideas about how you can be **active**.
 TIME _____

MPS 12: Learning **Being active: Ideas**

- Read
- Read + underline
- read + underline + concept map/notes
- Read + underline + map + summary
- Read + underline + map +sum + elaborate

MPS 12: Learning **Work cooperatively & not competitively** . Research says... cooperate
 Force field diagram : How to do this without being accused of copying/ cheating



MPS 12: Learning High Quality & numerous interactions with professors & students outside of class

What can you control?

Activity as <u>individual</u> <u>group of</u> Brainstorm ideas on this TIME _____

Share

12

MPS 12: Learning Get Prompt feedback

Teacher owns this one.... or does he/she?

How might you get prompt feedback on your learning task?

Activity: as group of _____ Brainstorm ideas TIME _____
--

14

MPS 12: Learning : Ideas

Reflections _____

13

MPS 12: Learning Ideas

Reflections _____

15

● **MPS 12: Learning Exploit teacher's learning environment.**

You don't have control over what environment the teacher elects to use:

- lecture
- cooperative groups
- teams
- Discussion
- Presentations
- Laboratories
- Problem-based learning

But... you can understand and exploit the uniqueness of each.

Often, professor uses the lecture
This is passive, you sit, make notes....

10 to 50% from Dale's cone for learning

Is the lecture for Learning?

● 16

● **MPS 12: Learning Purpose of the lecture**

- get personal experience of prof.
- repetition
- ask questions
- get hints for tests
- see examples worked
- see problem solving style
- get information that is not in text
- get verbal explanations
- keep up a routine
- I paid for it!

- Feel good about myself
- feel I am accomplishing something
- all my friends go
- forces me to keep up
- get the emphasis
- clarification of difficult stuff
- different viewpoint
- take notes

● **MPS 12: Learning Lecture :**

Activity: as groups of 3 to 4 what is the purpose of the lecture? Why go? What can you gain from a lecture that you cannot gain from reading the required text?

TIME 5 min

●

Report Ideas

● 17

● **MPS 12: Learning Purpose of the lecture**

●

Write reflections _____

MPS 12: Learning Lecture notes

Bring your lecture notes from day _____ for course _____.

In a set of information; there is usually

- the subject knowledge eg. Fundamentals of Chemical Engineering
- examples values, applications
- suggestions for problem solving

Activity As _____ For the first 15 min, classify the information into these categories and then identify for the Subject knowledge:

1. The most important information for you to learn
2. The most important concept introduced
3. The fundamental law behind that concept

TIME _____

Option-20

MPS 12: Learning Lecture notes

With the lecture notes in hand,
Form a line based on Jungian typology

S _____ N

Number off, # 1 (dominant S) get together with number middle of line, #2 with _____ with next; and so on until middle is together with dominant N.

In pairs, compare lecture notes.

TIME _____

Reflections _____

Option-22

MPS 12: Learning Lecture notes

FIG 16.5 Example of Student B's notes

Student B 14-1-75

Reactions involving only solids or liquids - no noticeable volume change

$\Delta H = \Delta E$

Enthalpy changes the bond E for the H-Cl bond

$HCl = H + Cl ; \Delta H = - 103 \text{ kcal/mole}$

$CH_3Cl = CH_3 + Cl ; \Delta H = + 80$

chloromethane methyl radical C-Cl bond E

Average Bond Dissociation Energies

eg. P-H 77 From $PH_3 \rightarrow P + 3H ; \Delta H = 230$

APPLIKATIONS: Finding enthalpy of reaction without doing it in Lab.

FIG 16.7 Example of Student A's notes

14-1-75 1.41, 15.5

Reactions involving only solids or liquids - any volume changes usually negligible

$\Delta H = \Delta E$ since (PV) neglect

Bond Energies

Enthalpy changes $H_2(g) + Cl_2(g) \rightarrow 2HCl(g) ; \Delta H = - 183 \text{ kcal mole}^{-1}$

$CH_3Cl(g) \rightarrow CH_3(g) + Cl(g) ; \Delta H = + 80$

chloromethane methyl radical C-Cl bond energy

- direct measure of the strength of the bond

Average Bond Dissociation Energies

eg. P-H 77 I - $PH_3(g) \rightarrow P(g) + 3H(g) ; \Delta H = 230$

Si-Cl 101

C-O 101.5

ΔH

Option-21

MPS 12: Learning Lecture notes

You receive of copy of the lecture notes taken by the instructor who has a Jungian SN indicator of _____

In groups of _____ Compare your notes with those of instructor.

Report:
Similarities _____ Differences _____

Reflections TIME _____

Option-23

MPS 12: Learning Lectures.

Your professor uses the lecture format.
Your professor is SN..... _____

Activity: Form small groups of 3 or 4 that have similar SN Jungian typology.

In the context of the lecture, what might you request of the instructor to improve your learning.

TIME _____

Share ideas

Option-24

MPS 12 Learning Lecture: ideas of requests of professor to improve your learning

- summarize key ideas
- present major ideas visually, verbally & symbolically
- use ombudspersons
- give us 2 minutes every 20 minutes to write reflections about what we have learned so far
- help us to see the main points
- give us his/her version of concept maps for sections
- tell us what to read ahead of time before class
- let us complete the Course Perceptions Questionnaire after midway through the course.
- tell us his/her Jungian SN and TF dimensions
- tell us his/her view of the purpose of the lectures.
- ask the Chair of the Department to ask professor to do the above

Option-26

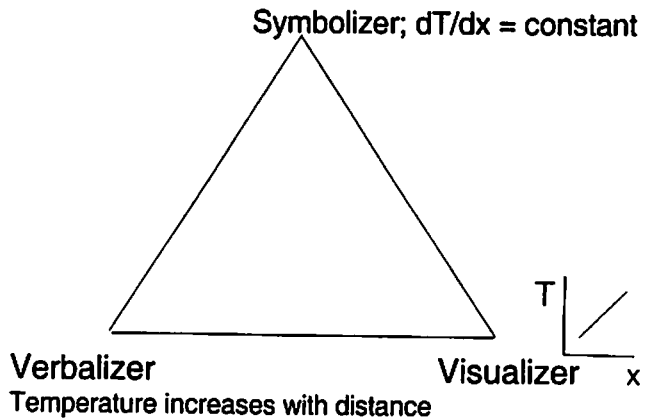
MPS 12 Learning Lecture: Ideas to request of professor to improve your learning.

Option-25

MPS 12: Learning Your personal learning style

From MPS 11, p. 1112 Consider the results of inventories and reflect.... does this represent me?
Implications for studying and learning.

Visual diagrams? Show me	symbolic Equations? Write equns	verbal Word Explain it
-----------------------------	------------------------------------	---------------------------



Option-27

MPS 12: Learning Learning style

Example: how do you think about this problem?

A tolquot is equal to 4 quamquats. Vessel A has a base of 1 tolquot by 1 tolquot with a height of 1 quamquat. Vessel B has a base of 1 quamquat by 1 quamquat with a height of 1 tolquot. Which vessel holds more water?

Draw a sketch?

Use symbols $1 T = 4 Q$

Vessel A is $T \times T \times Q = \text{volume} = 4Q \times 4Q \times Q$

Vessel B is $Q \times Q \times T = \text{volume} = Q \times Q \times 4Q$

Option-28

MPS 12: Learning Your learning style

In clusters with similar learning styles based on Visualizers, verbalizers, symbolizers and on Jungian SN

S Visualize

S Verbalize

S symbol

Visualize

Verbalize

Symbol

N Visualize

N verbalize

N symbol

Activity Discuss:

lectures, Lecture note taking
selection of textbooks
selection of study partners.

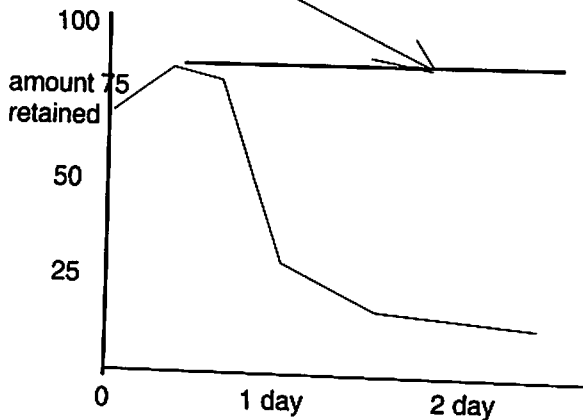
TIME _____

Option-29

MPS 12: Learning Improving retention

Research says.....

- write it
- review systematically To maintain need first review for 10 min after 10 after
- 2nd review 2 min after 24 h
- 3rd 10 min after 1 week
- 4th 10 min after 1 month
- 5 th 10 min after 6 months



Option-30

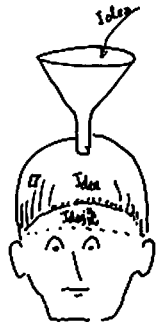
MPS 12: Learning Research says:

1. New Knowledge is understood in the context of old
2. Knowledge has structure
3. Knowledge is used for a purpose

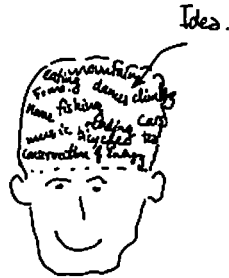
Option-31

1. New knowledge is understood in the context of old knowledge

not an empty vessel to be filled



Where does new fit in?



Option-32

MPS 12: Learning New into old, So What?
Possible misconceptions.

Examples in Physics.

Misconception

- Mass cannot discriminate from weight
- Friction cannot establish casual relationship between normal force & retarding force
- Acceleration is dependent on mass of object due to gravity

Electric power & current describe same physical quantity

Electrons get used up as a battery wears down

Concept _____
Possible misconception _____

Option-33 B

my head is full

Option-33 A

MPS 12: Learning New into old. So what?

- Identify new concept carefully; think about past experience. Do you think of it this way? Misconceptions? Work as defined in Physics. Acceleration, Velocity Force, work energy, power, heat Many examples in Physics Note differences between precise definitions used in science & engineering and the everyday use.
- Elaborate on new ideas in context of old. What is this related to? Similar to? Different from? Easy to confuse with?

Activity: for the concept of _____ list 10 everyday experiences that might be related

TIME _____

Option-34 A

MPS 12: Learning New into old, So What? Ideas

List How related?

MPS 12: Learning Knowledge has structure & vital interconnects and conditions

- hierarchical
- with fundamental laws on top, - surface structure, approximations, simplifications, special cases are at the lower levels.
- encoded with the fundamentals are *chunks* that encode the fundamentals to identify the conditions, constraints when the knowledge is applicable .
- “concepts” are defined to allow us to apply the fundamentals easily.
- encoded with subject knowledge should be experience or tacit knowledge that allow us to work qualitatively with the knowledge.
- knowledge is organized in *chunks* for convenient processing.

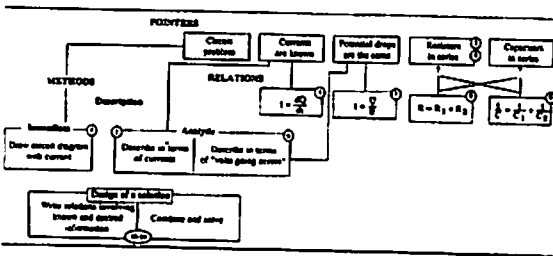
Option-34 B

Option-35

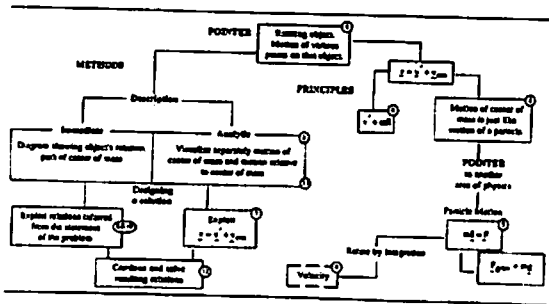
MPS 12: Learning Knowledge Structure, eg.

MPS 12: Learning Knowledge Structure

a. Unsuccessful problem-solver's script for a circuit problem

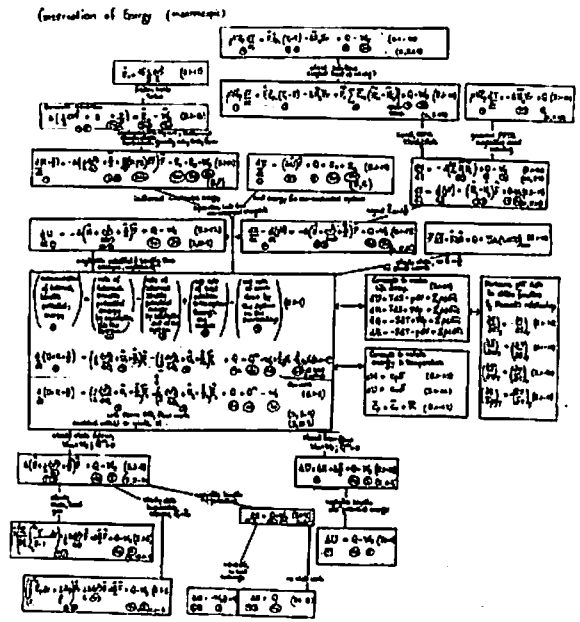


b. Successful problem-solver's script for a falling-disk problem.

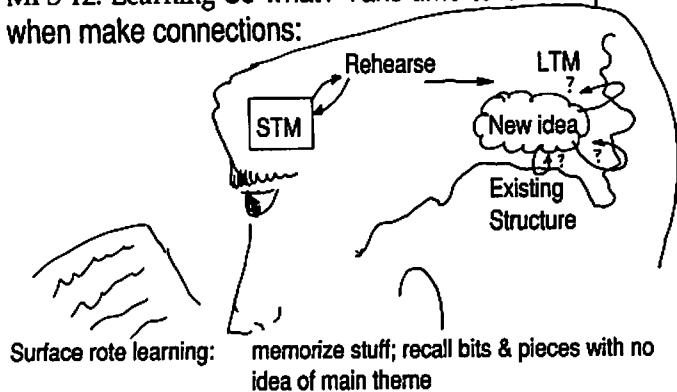


Option-36

Option-37



MPS 12: Learning So what? Take time to be complete when make connections:



Surface rote learning: memorize stuff; recall bits & pieces with no idea of main theme

Semi-deep recalls conclusions but no idea of reason, evidence, basis fundamentals underlying it.

Deep conclusion, equations, main theme, context, evidence, conditions

Use Approaches to Studying LASQ to provide idea of current emphasis.

Option-38

MPS 12: Learning Fundamentals in Science & Engineering. Fundamental law is a *universally applicable explanation of how things behave*. We have about 8 laws.

1. Conservation of mass (& of elements) except for nuclear reactions or $E = mc^2$
- 2.. Conservation of momentum
3. Conservation of charge
4. Conservation of energy except for nuclear reactions or $E = mc^2$
5. Second law of thermodynamics: criteria for stable equilibrium: Systems at constant pressure and temperature adjust to try to minimize the total Gibbs free energy in the system.
6. Reactions occur in stoichiometric proportions. *Think moles!*
7. At equilibrium, to every action there is an equal and opposite reaction.
8. $F = ma$
9. You can't push on a rope.

Most of the so-called "laws" are *wishes*. Ideal gas wish. Raoult's wish. Henry's wish. Einstein's wish for viscosity, Newton's wish for viscosity, Fourier's wish for thermal conductivity; Fick's wish for diffusion.

Option-40

MPS 12: Learning Examples from Physics

~~force~~

force.. acts on < >
force... on <particle> by <other particles>

~~acceleration~~

acceleration of < particle> at <time> relative to <reference plane>.

~~Model correlation law~~

correlation that applies for <condition>, <condition> and <condition> to < ± accuracy > and that needs <input data>.

Option-39

MPS 12: Learning

1. Law always
- 2 (Wish/ constrained law) simplified definition, use of a law
3. Theory relates dependent and independent variables & mostly based on laws or wishes
4. Model representation to explain behavior
5. Balance equation applied to a conserved entity
6. Empirical correlation no model used. Curve fit and "constants" determined from experiments.
7. Semi-empirical correlation model where the "constants needed to match reality are determined from experiments. Identify conditions.
8. Concept general term for idea
9. Convention agreed-upon set of rules
10. Postulate simplified set of agreed-upon conditions

Option-41

MPS 12: Learning vapor-liquid equilibrium

At equilibrium, & constant T and P the Gibbs free energy in one phase for the species (chemical potential) = Gibbs free energy for that species in the other phase.

$$\sum x_i d\mu_i = 0$$

$$x_1 = \frac{P_1}{P} = \left(\frac{V_1^L}{V_1^V} \right) \left(\frac{P_1^L}{P} \right) \exp \left[\frac{V_1^L}{RT} (P - P_1^L) \right] \exp \left[\frac{RT}{P} \int_0^P \left(\frac{V_1^V}{P} - \frac{V_1^L}{P} \right) dP \right] \quad (33)$$

Mixture Activities V.P. Liq. fugacity corr. Vapor fugacity corr. (Poynting)
 Ideal solution Pure component

Liquid incompressible ($V_1^L = \text{const.}$):

$$x_1 = \frac{P_1}{P} = \left(\frac{V_1^L}{V_1^V} \right) \left(\frac{P_1^L}{P} \right) \exp \left[\frac{V_1^L}{RT} (P - P_1^L) \right] \exp \left[\frac{RT}{P} \int_0^P \left(\frac{V_1^V}{P} - \frac{V_1^L}{P} \right) dP \right] \quad (37)$$

Fugacity correction negligible ($n < 20$ atm and $T > 0^\circ\text{C}$):

$$x_1 = \frac{P_1}{P} = \left(\frac{V_1^L}{V_1^V} \right) \left(\frac{P_1^L}{P} \right) \exp \left[\frac{RT}{P} \int_0^P \left(\frac{V_1^V}{P} - \frac{V_1^L}{P} \right) dP \right] \quad (38)$$

Vapor solution ideal ($V_1^V = 1$), ($n < 20$ atm, $T > 0^\circ\text{C}$):

$$x_1 = \frac{P_1}{P} = \left(\frac{V_1^L}{V_1^V} \right) \left(\frac{P_1^L}{P} \right) \exp \left[\frac{RT}{P} \int_0^P \left(\frac{V_1^V}{P} - \frac{V_1^L}{P} \right) dP \right] \quad (39)$$

Liquid solution ideal ($V_1^L = 1$), (close neighbors of homologous series, and $n < 10$ atm, $T > 0^\circ\text{C}$):

$$x_1 = \frac{P_1}{P} = \left(\frac{P_1^L}{P} \right) \exp \left[\frac{RT}{P} \int_0^P \left(\frac{V_1^V}{P} - \frac{V_1^L}{P} \right) dP \right] \quad (40)$$

Vapor follows ideal gas law ($n < 2$ atm, $T > 0^\circ\text{C}$):

$$x_1 = \frac{P_1}{P} = \frac{V_1^L}{V_1^V} \left(\frac{P_1^L}{P} \right) \quad (41)$$

Completely ideal system ($V_1^L = 1$, $n < 2$ atm, $T > 0^\circ\text{C}$):

$$x_1 = \frac{P_1}{P} = \frac{P_1^L}{P} \quad (42)$$

Option-42

MPS 12: Learning: vapor-liquid equilibrium

example concept map

Option-43

MPS 12: Learning

For the concepts, "laws" and wishes you are learning, identify which of the 10 pertains (TR 39).

With the help of the professor or the TA find the connection.

Jill Larkin created a checklist to be used to remind us of the types of information we need to determine (and internalize) for equations, "laws", concepts.

Larkin found that concepts and equations that are most difficult are...

Those that use symbols or concepts that have multiple meanings:

x mole fraction? Mass fraction?

Option-44

MPS 12: Learning Larkin's research

Physics :

$F = ma$	$x = v_0 t + \frac{1}{2} a t^2$
$F = \Sigma F$	$v = v_0 + a t$
$f = \mu N$	$v^2 = v_0^2 + 2 a x$
$N = mg \cos \theta$	$v = (v_0 + v) / 2$
$F'g = mg \sin \theta$	$x = v t$

$$\Delta K = \frac{1}{2} m v^2 - \frac{1}{2} m v_0^2$$

$$W = \Delta K$$

$$W = Fx$$

Option-45

MPS 12: Learning Larkin checklist

MPS 12: Learning

Which symbols have different meanings depending on the context?

Do you experience similar challenges in the subject you are studying?

Activity: Complete a Larkin checklist for _____

TIME _____

Concept: NEW QUANTITIES IN EQUATIONS Properties (1) Kind (number, vector, ...) (2) Signs or directions (3) Units (4) Typical Magnitude	Equation form.			
MEANING (in words)				
ANY SIMILAR QUANTITY THAT MIGHT CONFUSE?				
• THE COMPLETE EQUATION: COMMENTS: WHEN APPLICABLE?				
OTHER IDEAS WHICH ARE EASY TO CONFUSE WITH THIS? Similarities: Differences:				

Option-46

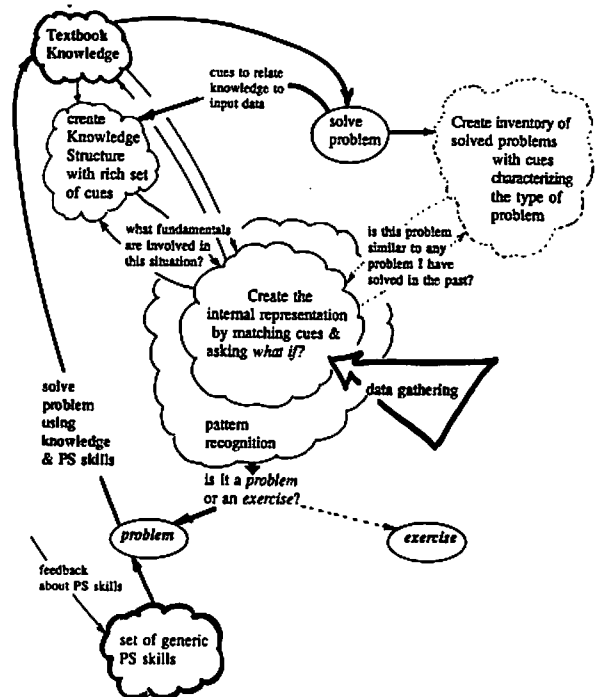
Option-47

MPS 12: Learning Larkin checklist

Concept: _____ (Name)
• Verbal Statement:
• Visual Graphs: Experiment:
• Mathematics or Equations
• Combinations. Is this combination of previous ideas? Can this be combined to give new ideas?

Option-48

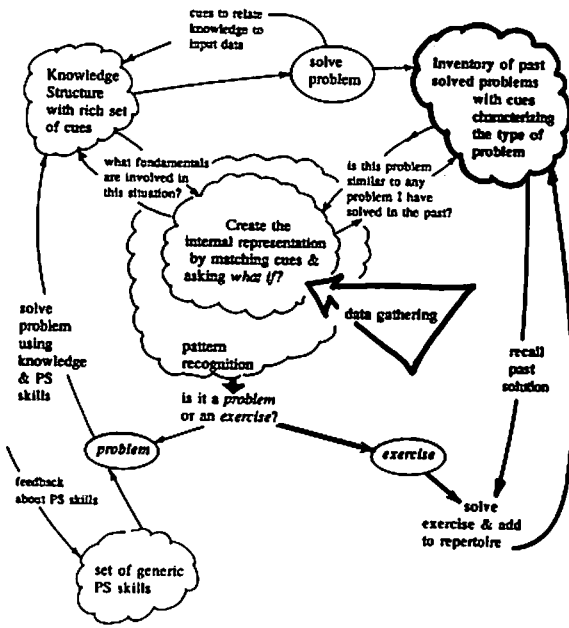
MPS 12: Learning Knowledge has a purpose to solve problems Problem solving



Option-49

MPS 12: Learning: Knowledge has a purpose:

... to solve problems: exercise solving



Option-50

MPS 12: Learning Knowledge & problem solving So what? Research says....

Unsuccessful

immediately translate into symbols and focus on symbol manipulation without understanding what is really going on. "I know, this is the equation that applies"

Tend to start on the abstract end of Kolb's learning cycle or recalling worked examples

Use a strategy of cooking past sample solutions to match the current situation.

Use "surface wording" of the problem statement to incorrectly identify what they think is going on.

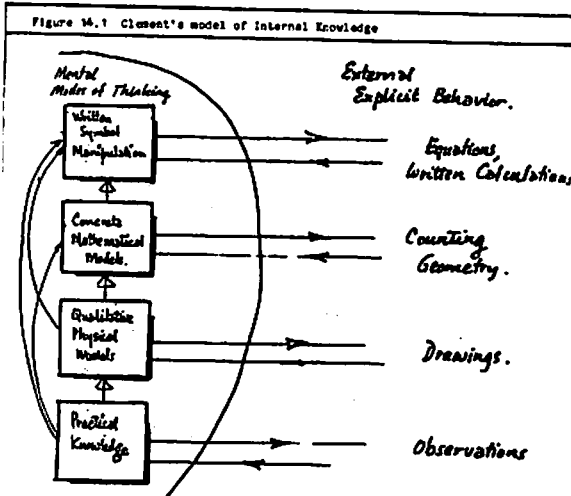
Successful

Focus on the observations; describe in words what's going on. Tend to start with concrete events in Kolb's cycle.

Focus on identifying the fundamentals & later relate to possible worked examples.

Look beyond the surface wording and identify the fundamental phenomena that pertains. "Which of the fundamental laws applies?"

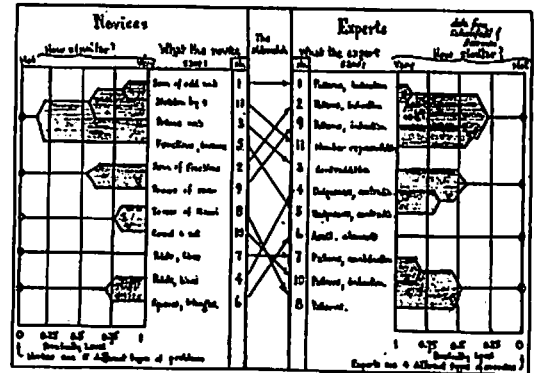
MPS 12: Learning Clement's research



Option-52

MPS 12: Learning Schoenfeld's research

Figure 4-2 The results of Pattern recognition of novices versus experts



Unsuccessful looks at words

Successful considers principles

Option-53

MPS 12: Learning Memorize *pointers* and *cues* that identify fundamental law that applies and conditions.

MPS 12: Learning When creating the internal representation we need to be able to estimate, approximate, play around with ideas. We need *Experience knowledge*: Memorized, values to allow us to use the knowledge.

Velocity: how fast does a car travel 2000 km/h? 1 km/h?

What is a reasonable value for Henry's law constant?

For the density of water

for the density of benzene?

For the molar mass of carbon dioxide?

Activity: create a list of memorized values... with units... for the course so far.

TIME _____

Option-54

Option-55

MPS 12: Learning

SUMMARY:

Use an "O" to summarize your

current awareness and skill

TIME ____ FINISH BY ____

OBJECTIVES.....

MPS 12: Learning

DISCOVERY

Discovered

Application

Option-56

Option-57