

Cognitive Learning Theories

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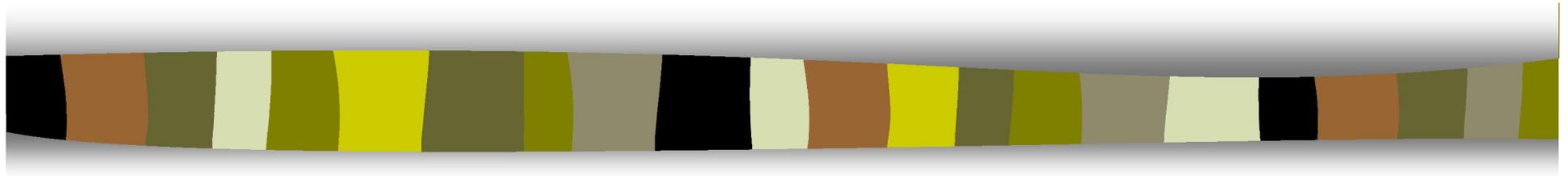
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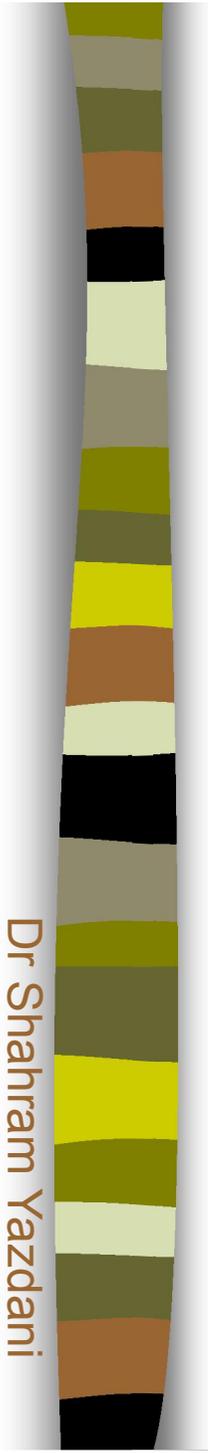
Problem-Based Learning



Roger Schank

Problem-Based Learning

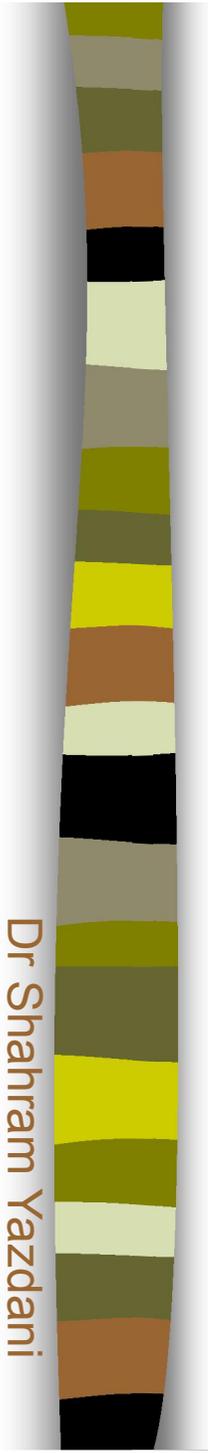
- Learning that is situated around an event, case, problem, or scenario.



Problem-Based Learning

Five Strategies for Using PBL (Duffy & Cunningham, 1996):

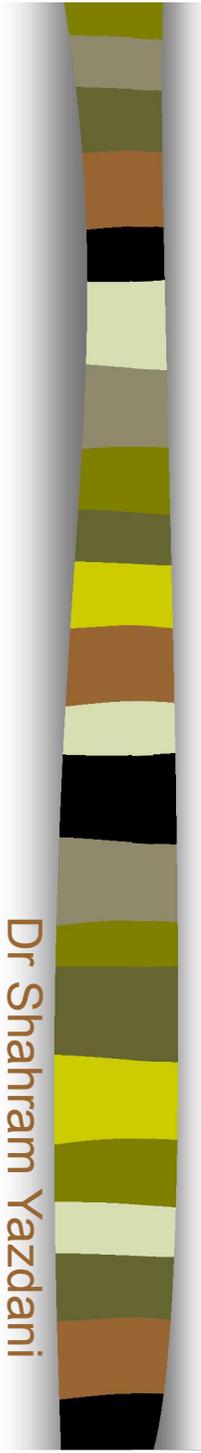
1. *The Problem as a Guide*: the problem is presented in order to gain attention prior to presenting the lesson.



Problem-Based Learning

Five Strategies for Using PBL

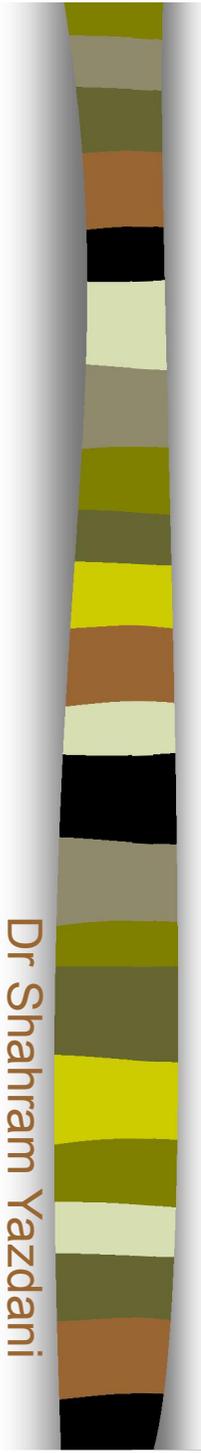
2. *The Problem as an Integrator or Test:* the problem is presented after readings are completed and/or discussed -- these are used to check for understanding.



Problem-Based Learning

Five Strategies for Using PBL

3. *The Problem as an Example*: the problem is integrated into the material in order to illustrate a particular principle, concept or procedure.



Problem-Based Learning

Five Strategies for Using PBL

4. *The Problem as a Vehicle for Process:* the problem is used to promote critical thinking whereby the analysis of how to solve it becomes a lesson in itself.

Problem-Based Learning

Five Strategies for Using PBL

5. *The Problem as a Stimulus for Authentic Activity*: the problem is used to develop skills necessary to solve it and other problems -- skills can include physical skills, recall of prior knowledge, and metacognitive skills related to the problem solving process. A form of authentic assessment of the skills and activity necessary in the content domain.

Problem-Based Learning

- ***Design PBL Instruction:***
 1. ***Task Analysis:*** analysis must take place not only within the content domain but should also determine the actual setting where the learning will be authentic.
 2. ***Problem Generation:*** The problems must be constructed so they include the concepts and principles that are relevant and they must be set in a real context.

Problem-Based Learning

■ *Learning Sequence:*

1. Collaborative Analysis session where groups work together to solve the problem.
2. Self-directed Learning where the students identify the information and resources that are necessary to solve the problem.

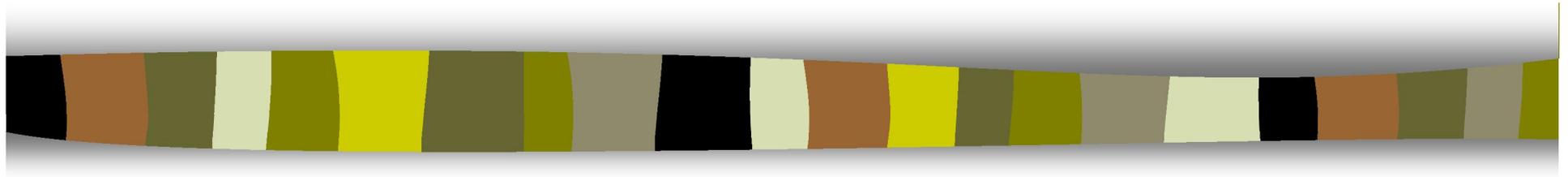
Problem-Based Learning

- The instructor in PBL only acts as a facilitator to learning, instead of a transmitter of the necessary information.

Problem-Based Learning

- *Assessment:* assessment of learning must occur within the context of the problems and should be in the form of both self assessment and peer assessment.

Conditions of Learning



Robert Gagne

Conditions of Learning

- Gagne's theory defines five major categories of learning that each require a different type of instruction in order for learning to occur. The five categories are: verbal information, intellectual skills, cognitive strategies, motor skills, and attitudes.

Conditions of Learning

Nine events of Instruction

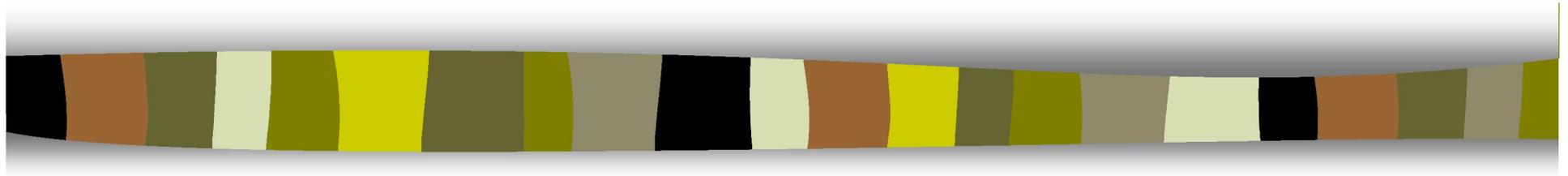
(Ragan & Smith, 1996)

1. Gain Attention
2. Inform the learner of the objective
3. Stimulate recall of prior knowledge
4. Present stimulus material
5. Provide learning guidance
6. Elicit performance
7. Provide feedback
8. Assess performance
9. Enhance retention and transfer

Conditions of Learning

- Major Principles of Gagne's Theory (Kearsley, 1998)
 1. Different instruction is needed for different learning outcomes.
 2. Events of learning operate on the learner in ways that constitute conditions of learning.
 3. The specific operations that constitute instructional events are different for each type of learning outcome.
 4. Learning hierarchies define what intellectual skills are to be learned and a sequence of instruction.

Meaningful Learning



David Ausubel

Ausubel views knowledge as representing an integrated system. Ideas are linked together in an orderly fashion.

The human mind follows logical rules for organizing information into respective categories.

Mind, metaphorically, is like a Chinese puzzle box. All the smaller boxes, ideas and concepts, are tucked away inside of larger boxes.





Subsumption is the central idea running through the whole of Ausubel's learning theory. The big boxes in the mental pyramid subsume the small boxes.

Subsumers constitute the general categories around which we organize our thinking.

Subsumption allows us to absorb new information into our cognitive structures.



Teaching and learning, therefore, are largely matters of **erecting cognitive structures** (scaffolding) to hold new information.

By placing information into its proper box, we are better able to retain it for future use. Similarly, forgetting occurs when the smaller boxes (being made of less durable cognitive stuff) fall apart and become incorporated into the larger boxes.

Ausubel emphasizes the learner's cognitive structure in the acquisition of new information.

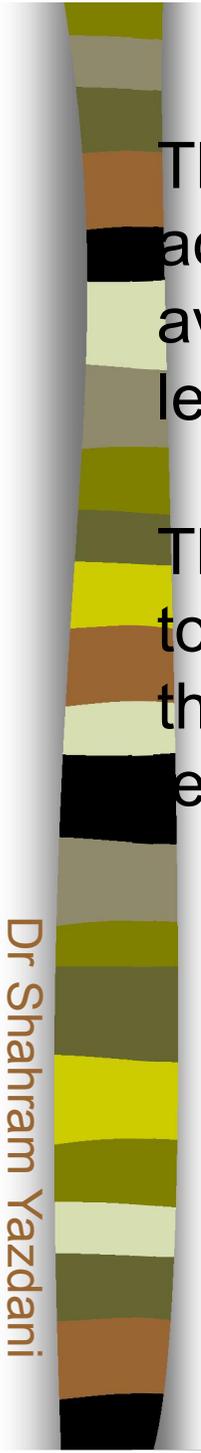
Present experience is always fitted into what the learner already knows.

"Existing cognitive structure, that is an **individual's organization, stability, and clarity of knowledge** in a particular subject matter field at any given time, is the principal factor influencing the learning and retention of meaningful new material".

A cognitive structure that is **clear and well organized** facilitates the **learning and retention** of new information.

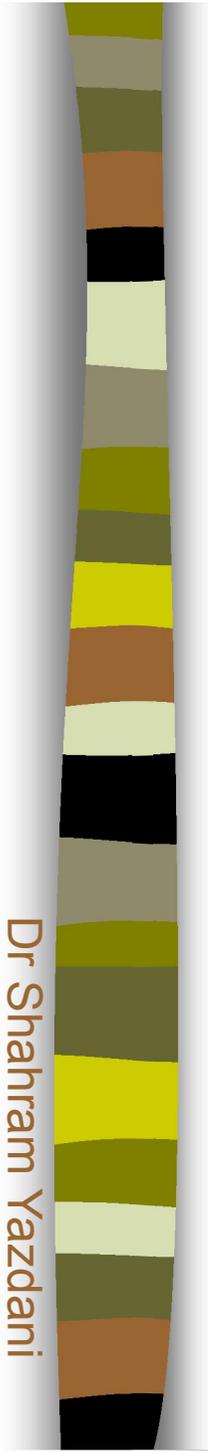
A cognitive structure that is confused and disorderly, on the other hand, inhibits learning and retention learning can be enhanced by strengthening relevant aspects of cognitive structure.

Putting the mind in order is one of the principal objectives of all education.



The major **concepts** (subsumers) in cognitive structure act as anchoring posts for new information. The availability of anchoring ideas facilitates meaningful learning.

The cognitive stability provided by anchoring ideas helps to explain why meaningful learning is retained longer than rote learning. Meaningful learning is anchored; rote learning, is not.



Rote Learning and Meaningful Learning

- **Rote Learning:** the learner memorizes and makes no connection between what was known and what was memorized.
- **Meaningful Learning:** the process of relating potentially meaningful information to what the learner already knows in a substantive way.

Meaningful Learning

- Meaningful learning occurs when learners actively interpret their experience using internal, cognitive operations.
- Prior knowledge is the most significant in determining what new learning will occur.
- "The model of cognitive organization proposed for the learning and retention of meaningful materials assumes the existence of a cognitive structure that is hierarchically organized." (Ausubel, 1963, p. 217)

Meaningful Learning

- Ausubel emphasizes the reorganization of existing cognitive structures.
- Ausubel believed that you should ascertain the cognitive structures of your learners and teach them accordingly.

Assimilation

- *Assimilation* concerned with how individuals learn large amounts of meaningful material. The primary process in learning is that new information is related to relevant knowledge that is already existing in an individual's cognitive structure.

Steps in Assimilation

- The steps to this process are:
 1. **Subsumptive**: meaning and new examples are added to an existing concept
 2. **Superordinate**: ideas and concepts are synthesized and therefore new inclusive concepts are created
 3. **Combinatorial**: additional background is added to achieve a more global understanding of the concept.

Principles of Meaningful Learning

■ Principles:

1. The most general ideas of a subject should be presented first and then progressively differentiated in terms of detail and specificity.
2. Instructional materials should attempt to integrate new materials with previously learned material by comparing new and old ideas and concepts.

Meaningful Learning

Key Concepts

- **Cognitive Structure:** the learner's overall memory structure or integrated body of knowledge.
- **Anchoring Ideas:** the specific, relevant ideas in the learner's cognitive structure that provide the entry points for new information to be connected.
- **Reception Learning:** the entire content of what is to be learned is presented to the learner in its final form.

Advanced Organizer-1

- Cognitive structure and anchoring ideas within the cognitive structure are the prerequisites to meaningful learning.
- Presentation and reception of a learning may go properly if the learner possess the relevant previous experiences and needed cognitive structure for the purpose
- Organizers are particularly useful when learners do not already possess the relevant concepts needed in order to integrate new information into their cognitive systems.

Advanced Organizer-2

- Advanced organizer is the introductory material presented ahead of the learning task and at a higher level of abstraction and inclusiveness than the learning task itself.
- These are generally based on the major concepts, propositions, generalizations, principles and laws of a discipline, subject or topic going to be taught by the teacher.

Advanced Organizer-3

Purposes is to:

- Help to **bridge the gap** between what is already known and what is to be learned
- Explain, integrate and interrelate the material in the learning task with the previously learned material
- Play an effective role in inducing a proper set or bent of mind in the learner
- Help the learner in the task of processing and storing of information resulting in proper acquisition and retention of the new information and knowledge (*i.e.* influence learners' encoding process).

Deductive learning

In this organiser, the pupils are reminded of something they are already familiar with: classification of animals according to certain characteristics. After this, the teacher informs them that plants can be classified using the same method. This organiser can convince pupils that this subject is not really new but rather, is similar to something already learnt. Ausubel's teaching approach is **deductive** in nature. The advance organiser presents a wide range of concepts, and encompasses what is intended to be learnt.

Steps using deduction

- Step 1 (Give the generalization)

“Predators and prey are part of the life cycle of all living things. Our lesson today is about predators and prey”
- Step 2 (Clarify key term)

“Predator refers to animals that hunt other animals for food. Prey is the name given to the animals that are hunted and eaten by other animals.

Steps using deduction

- Step 3(Give examples)
“Some examples include hawks that catch and eat mice.”
- Step 4(Students gain experiences by working with and/or by giving specific examples)
“Here is a list of animal names: I’d like you to look at it and tell which are the predator and which are the prey”
Groups the children – draw picture. Give string to connect between predator & prey.

Deductive learning

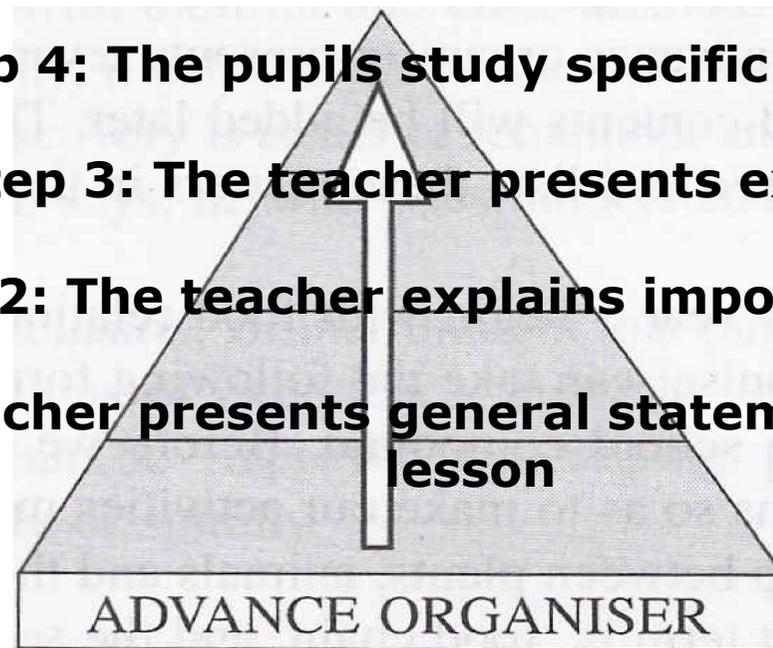
SPECIFIC

Step 4: The pupils study specific examples

Step 3: The teacher presents examples

Step 2: The teacher explains important terms

Step 1: The teacher presents general statement or abstraction of lesson



GENERAL

Types of Advance organiser

- The introductory information relevant to the content that is to be presented to pupils. The organiser presents an overview of the information to be covered.
- Divided by two :
 - (i) Advance Organiser of the exposition Type
 - (ii) Advance Organiser of the comparison Type

ADVANCE ORGANISER OF THE EXPOSITION TYPE

- While presenting new material to the pupils, the teacher can use an advance organiser of the exposition type at the beginning of the lesson. The organiser informs the pupils as to what needs to be learned and why.

ADVANCE ORGANISER OF THE COMPARISON TYPE

- Useful when the knowledge to be presented is new to pupils. However, in many cases, the pupils have knowledge similar to this new information. In this case, the teacher can use an advance organiser of the comparison type. A comparative organiser compares new material with knowledge already known by emphasising the similarities between the two types of material and showing the information that is to be learnt.



Examples of Advance organizers:

- **Expository**-simply describes the new content
- **Narrative**-presents new information in a story format
- **Skimming**-skimming material before reading can be a powerful organizer
- **Graphic organizers**-effective with all types of organizers: pictographs, descriptive patterns, concept patterns, etc.

Which students profit the most from the use of organizers?

Ausubel and Fitzgerald believe **good students**--those who already possess clear and well organized cognitive structures--**profit very little** from the use of organizers. This is because their minds are already programmed with anchoring ideas.

Slow learners, on the other hand, are the ones who benefit the most from the use of organizers. Such students require **additional assistance in learning how to structure their thinking.**

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Learners who possess **well organized** cognitive structures tend to **retain** information effectively.

Conversely, learners who have poorly organized cognitive systems tend to forget information rapidly. "Thus," concludes Ausubel , "it is largely by **strengthening** relevant aspects of cognitive structure that new learning and retention can be facilitated".

One way of improving retention is to introduce appropriate subsumers prior to presenting the new lesson.

Forgetting

Why do we forget information we labored so painstakingly to learn?

Just as subsumption explains how information is retained, so it also explains why forgetting occurs.

New information is stored when it becomes anchored to a larger subsuming concept. Reciprocally, this same information is forgotten as it becomes progressively absorbed into its cognitive host.

Forgetting is complete when the information can no longer be separated from its subsuming concept.

Ausubel refers to this process as "obliterative subsumption."

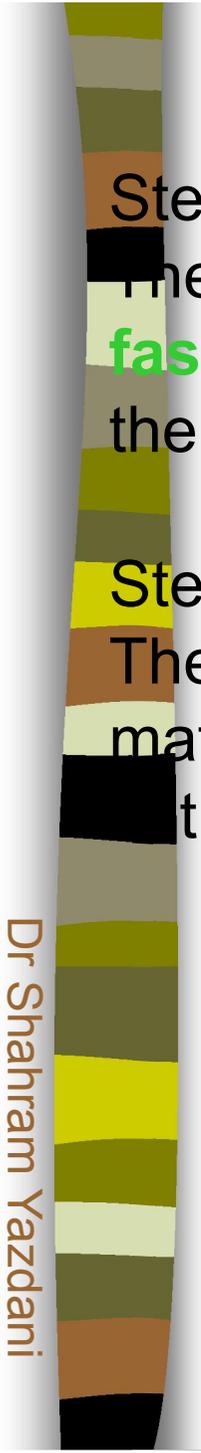
Ausubel Learning Theory teaching follows a **deductive** order. Instruction can be arranged in a sequence of five logical steps.

Step One:

The teacher ascertains if the student **already possesses relevant concepts** in his or her cognitive structure.

Step Two:

The teacher **provides appropriate advance organizers**, which are used to anchor the new material within established cognitive structure.



Step Three:

The teacher **present the new material in an organized fashion**, checking to make sure the student is subsuming the new information under appropriate organizers.

Step Four:

The teacher **provides sufficient practice** (drill) so that the material is thoroughly learned, becoming an integrated part of the student's cognitive system.

Types of Meaningful Learning

- *Representational Learning*: learning the meanings of unitary symbols or words. This is the most basic form of learning and serves as a foundation for all other learning to occur.
- *Conception Learning*: knowing beyond representation -- understanding the critical attributes that surround a concept and differentiate it from other concepts.
- *Propositional Learning*: the meanings of new ideas expressed in verbal prepositions are acquired -- individual words and concepts are now combined to form a new idea -- inferences are now being made by the learner.⁴⁸

Teachers' Role for Meaningful Learning-1

- Clarify the aims of the lesson
- Present the Advanced Organizer
- Present the learning material organized in a logical order taking proper cognition of the learners' Cognitive Structures

Teachers' Role for Meaningful Learning-2

- Ask students to provide a summary
- Ask them to differentiate between different aspects of the learning material
- Repeat precise definitions
- Ask students to provide additional examples of concepts / propositions
- Ask students to examine the material from alternative points of view
- Ask students to judge and challenge the assumptions and inferences
- Ask students to reconcile the contradiction (*if any*) perceived among them

Educational Applications

Rote Learning.

Ausubel's makes a distinction between **rote** and **meaningful** learning, which is important for teaching higher order thinking.

Rote learning occurs when the learner memorizes information in an arbitrary fashion. The knowledge or information is stored in an isolated compartment and is not integrated into the person's larger cognitive structure.

"Rotely learned materials are discrete and isolated entities which have not been related to established concepts in the learner's cognitive structure".

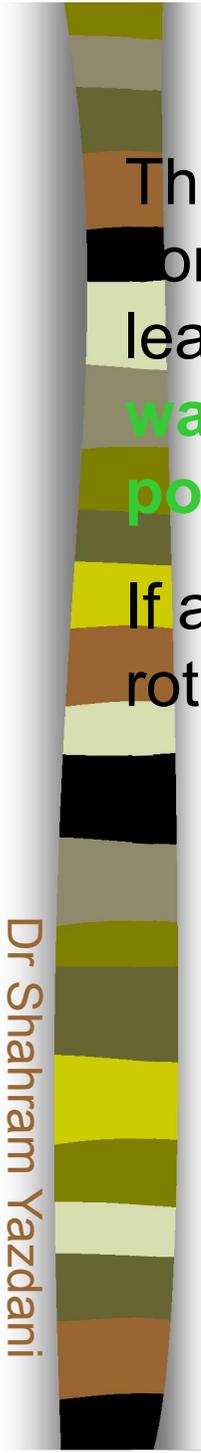
Because rote learning is not anchored to existing concepts, it is more easily forgotten.

Meaningful Learning.

Meaningful learning, on the other hand, is part and parcel to higher order thinking. Such thinking takes place when we **grasp the interrelationship between two or more ideas, old and new.**

"A first prerequisite for meaningful learning," Ausubel and Robinson contend, "is that the material presented to the learner be capable of being related in some `sensible' fashion".

The new information must be fitted into a larger pattern or whole. "Second, the **learner must possess relevant ideas to which the new idea can be related or anchored**".



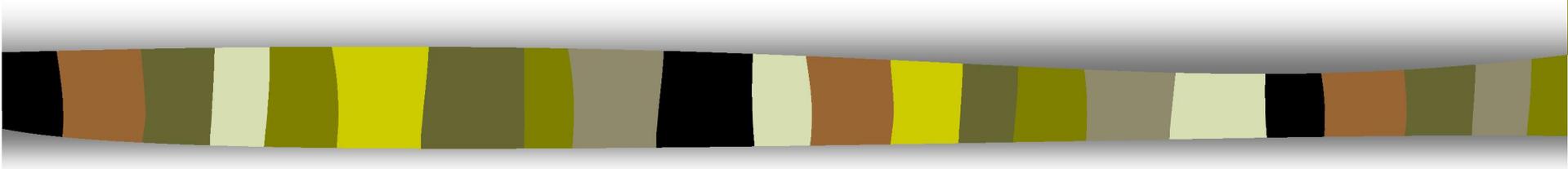
The learner must already have appropriate subsuming concepts in his or her cognitive structure. "Finally, the learner must actually **attempt to relate, in some sensible way, the new ideas to those which he presently possesses**".

If any of these conditions are missing, the end result will be rote learning.

Social Development Theory

- Four Assumptions about Learning:
 1. Signalization: something that is common to all organisms.
 2. Signification: humans have evolved to a different level; the stimulus is not the only thing connected to the response. A symbol system becomes part of the response. Meaning is assigned to an arbitrary stimulus.
 3. Biological: part of the evolutionary process
 4. Sociohistorical: creation and use of a culturally based signs and symbol system.

Social Learning Theory Observational Learning



Albert Bandura

Social Learning Theory

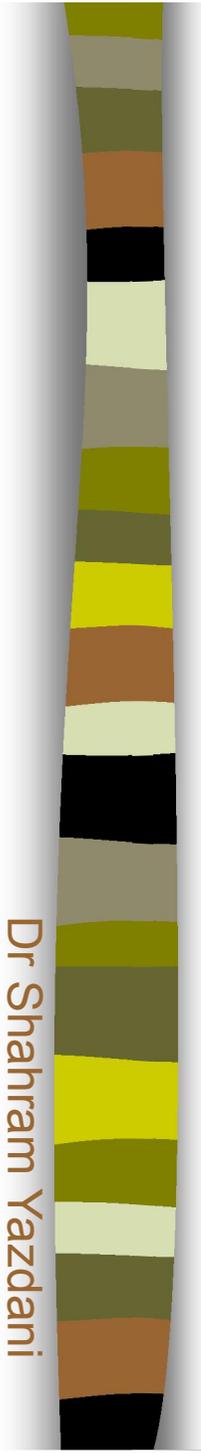
- **Social Learning Theory:** people are not driven by either inner forces or environmental stimuli in isolation; instead behaviors are learned through continuous interaction of personal and environmental determinants and all learning from direct experience occurs by observing other people's behavior. (Burton, Moore, & Magliaro, 1996).

Observational Learning

- Observation Learning Process (Burton et al., 1996):
 - **Attention Processes:** determine what is selectively observed and extracted
 - **Retential Processes:** patterns of behavior are attended to and retained
 - **Motor Reproduction Processes:** the behavior is reproduced and refined on a basis of feedback.
 - **Motivation:** the behavior is more likely adopted if it is considered valuable or functional.

Observational Learning

- A. Learn by watching: you don't have to do something in order to learn it
- B. Abstract, decide, engage: learners see something in the environment, abstract what they've seen, decide if it is important and then repeat the behavior.



Social Learning Theory

- **Reciprocal Determinism:** Interpersonal and nonsocial environmental factors come together. The behavior of individuals occurs because of prior interactions with other people AND with the immediate environment. (Glover, Bruning, & Filbeck, 1983)