e-Learning:

Education Models and Approaches

Computer Supported Learning

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Acknowledgments

Some material derived and adapted from:

MASTER- e-learning per la pubblica amministrazione

http://elite.polito.it/index.php/teaching/current-courses/247-master-elpa

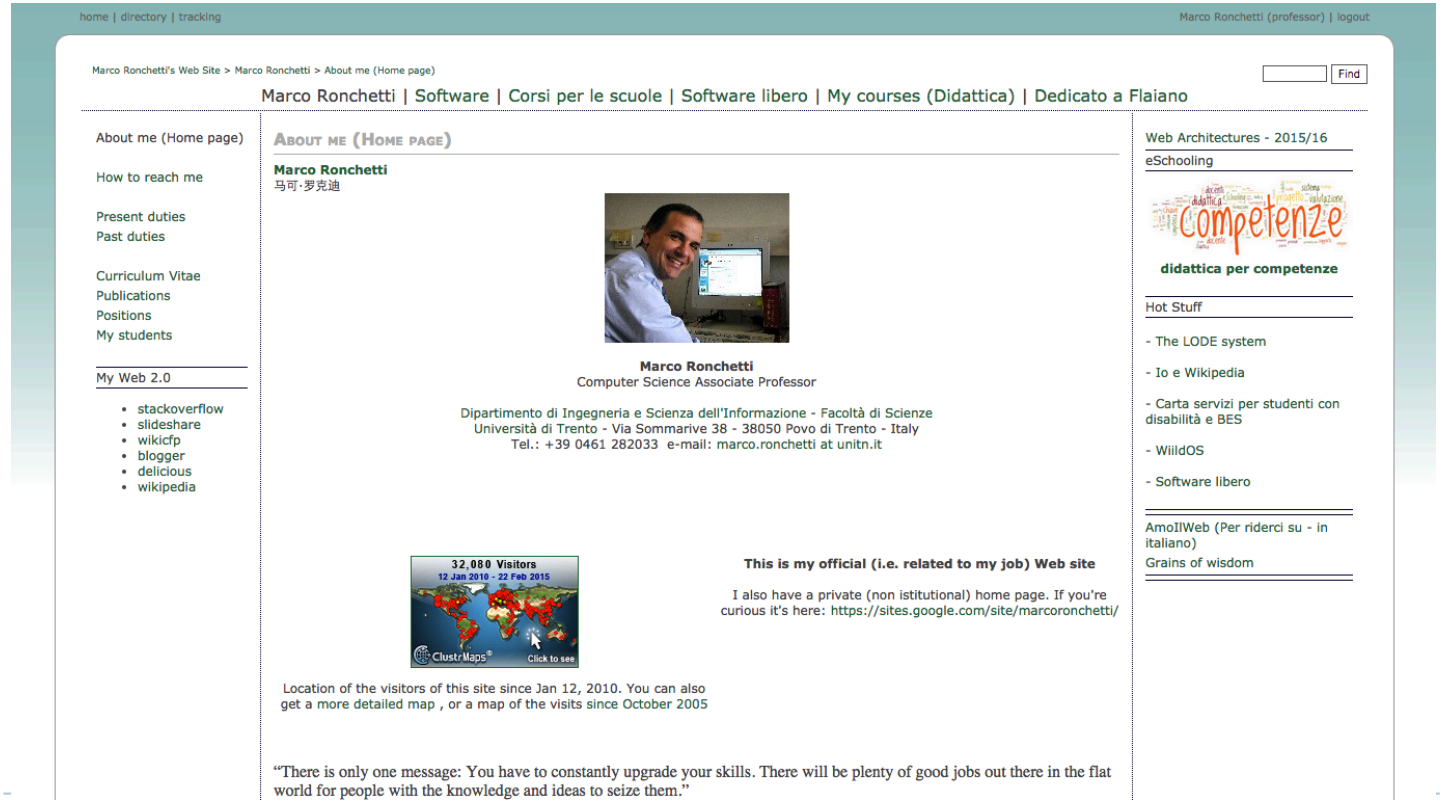
Licence

more about licences soon

Who am I

Who am I? Why I'm here?

see latemar.science.unitn.it



What will we be doing?

Education Models and Approaches

Computer Supported Learning

In learning, **co-construction** is a distinctive approach, where the emphasis is on collaborative, or partnership working.

Tools: Mind maps – concept maps

get Freeplane

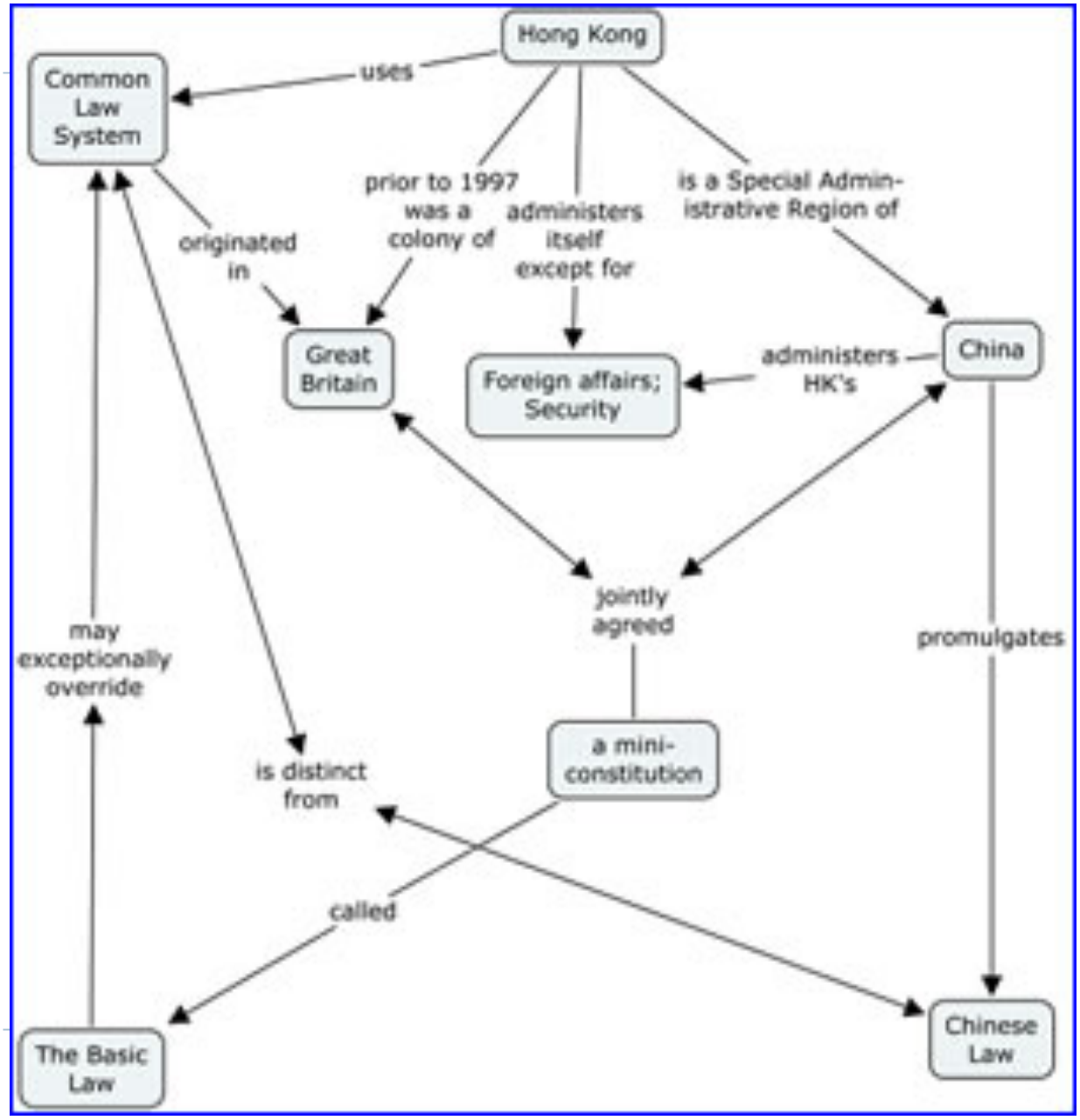
https://sourceforge.net/projects/freeplane/files/freeplane%20stable/archive/1.2.23/

Mind maps

- Tend to be more flexible and personal than concept maps.
- Are used to slice and dice the map's central topic or concept in multiple ways.
- May contain images and color, to make them more visually stimulating
- Topics in mind maps may only have one parent; in a concept map, a topic may have multiple connector lines, each one representing a different relationship.

see http://www.informationtamers.com/WikIT/index.php?title=Concept_maps_or_mind_maps%3F_the_choice

Concept maps



Concept maps

- Are commonly used to organize and represent tacit knowledge.
- Usually contain general concepts at the top of the map, with more specific concepts arrayed hierarchically below.
- Connector lines usually contains keywords or phrases that summarize the relationship between the topics they connect. Such as topic a “causes” topic B.
- Topics may be cross-linked with each other to depict more complex relationships between topics.

see The theory underlying concept maps and how to construct and use them. Joseph D. Novak & Alberto J. Cañas

http://cmap.ihmc.us/Publications/ResearchPapers/TheoryCmaps/TheoryUnderlyingConceptMaps.htm

Warming up…

1) What is learning? Give your definition.

2) Why there is an e-learning course in this Master?

Learning is…

… the act of acquiring new, or modifying and reinforcing knowledge, behaviors, skills, values, or preferences and may involve synthesizing different types of information.

The ability to learn is possessed by humans, animals, plants and some machines.

Progress over time tends to follow a learning curve.
It does not happen all at once, but builds upon and is shaped by previous knowledge.

Learning is a process.

Main Learning Theories

- Learning theories
  - Objective: explain how learning happens in humans.
  - Consequence: analysis of the teacher and learner roles in the formation process

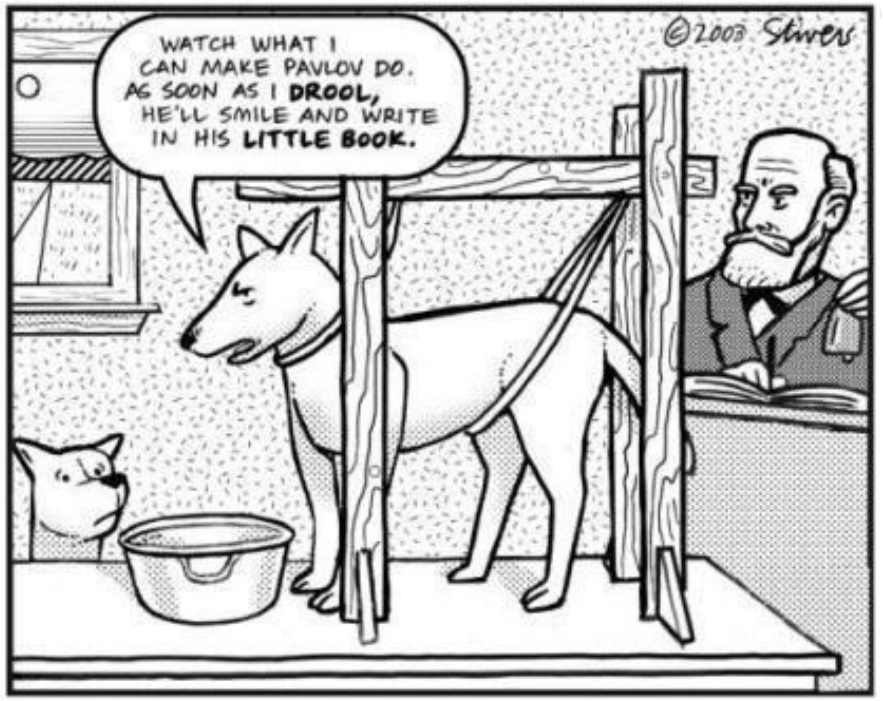
- Historical evolution
  - Behaviourims
  - Cognitivism
  - Constructivism

Behaviorism

- Theory based on the assumption that the explicit behavior of the individual is the only scientific evidence that can by studied in a scientific way, since it is observable.

For the behaviorist, the learning is nothing but the acquisition of a new behavior

Pavlov: stimulus - reaction



Classical conditioning (Pavlov)

Classical conditioning (also known as Pavlovian or respondent conditioning) refers to a learning procedure in which a biologically potent stimulus (e.g. food) is paired with a previously neutral stimulus (e.g. a bell).

It also refers to the learning process that results from this pairing, through which the neutral stimulus comes to elicit a response (e.g. salivation) that is usually similar the one elicited by the potent stimulus.

Programmed Instruction

- Technology invented by Burrhus Frederic Skinner (behaviorist psychologist) to improve the quality of teaching
- Based on "operating conditioning"
  - A Living being learns that his actions
  - have certain consequences
- Objective: introduce new didactic content
- Spelling machine
  - Sequence of cards designed to teach elementary school kids to write complex words

Skinner

https://www.youtube.com/watch?v=jTH3ob1IRFo

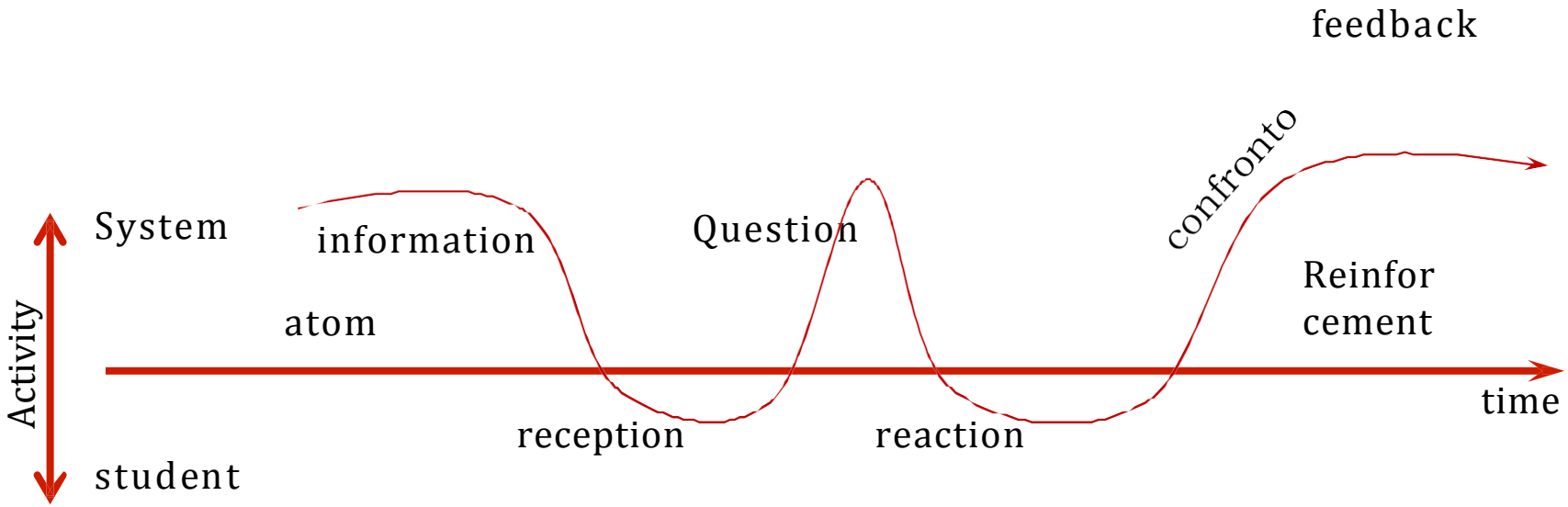
Long (30 min) https://www.youtube.com/watch?v=DeEBq2bhIZw

The Seven rules of programmed instruction

1. Every answer must have an immediate feedback
2. Students learn at their own pace
3. Learning objectives must be declared explicitly amd in a clear and objective way – Every topic must have a series of questions and answers
4. The topic sequence must happen an an increasing difficulty level, and must include multiple points of view
5. The student must be active, responding to questions
6. To have a positive reinforcement, tasks must be successful with probability higher than 90%
7. Better performance must be rewarded

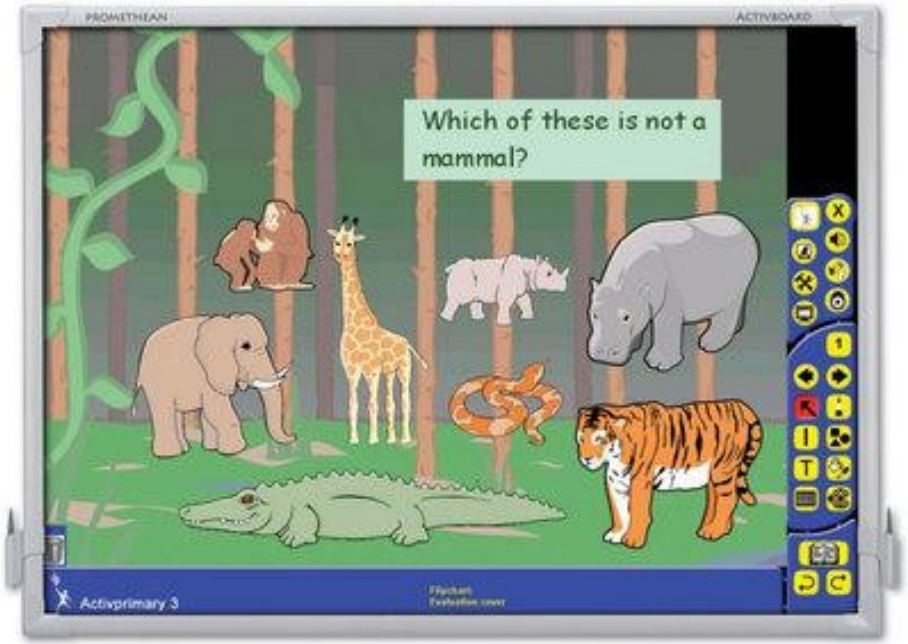
Programmed instruction: The “single step strategy”

- Teaching material is decomposed into "atoms"
- Every "atom" ends with a question (content recall)
- Task design: success probability must be higher than 90%
- Correct answer => positive reinforcement: go to next learning unit
- Wrong answer => repeat learning unit



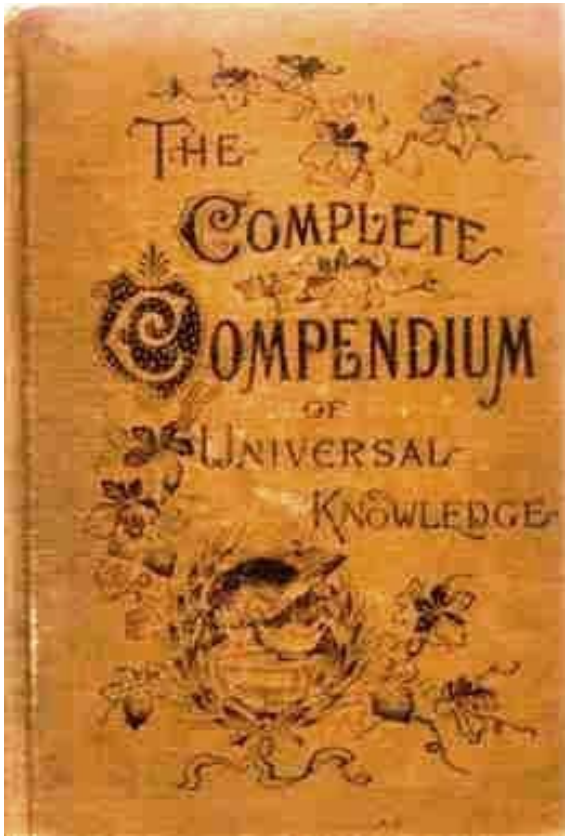
Drill & practice

- Another behaviorist approach
- Objective: put into practice the acquired notions
- Still used in programs for learning languages or math
- Characteristic: growing difficulty and time limit



Implications of the behaviorist approach

- The teacher knows what the student needs to know
- Teacher-centred approach: the teacher controls the learning process
- There is an optimal sequence of learning objects, which maximizes learning
- Students get the content, and can reproduce it (repeat) when requested



Main ideas

- Learning is a change in observable behaviour caused by external stimuli in the environment (Skinner)
- Observable behaviour indicates whether or not the learner has learned something (not what is going on in the learner's head).

Positive aspects

- Acknowledges the importance of planning with great care the learning material
- Acknowledges the importance of learning at one's own pace
- Focuses on student's performance
- Gives feedback on individual performance
- The system is patient, indifferent to the number of errors
- Suitable for drill and practice (learn to write, learn words, perform math operations, prepare for driving licence…)
- Suitable for memorization
- Focuses on answers speed
- Opportunity as part of more complex learning tasks
  - Math: exercises, multiplication tables
  - Languages: vocabulary
  - Other disciplines: facts (e.g.. dates in history)

Negative aspects

- Lack of clear-cut empiric evidence of its efficacy
  - Same efficacy by subdividing into atoms, but without feedback, or not following a redefined path
- 90% correctness is not more effective that other percentages
- Low level of students' acceptance (they feel controlled)
- Learning targeted at passing an exam (easy to forget)
- Passive learning (only reception)
  - difficult to activate tacit knowledge
  - difficult to transfer knowledge to a new domain, a new situation
- Low motivation level, low responsibility level
- Inappropriate for deep learning such ass problem solving

Cognitivism

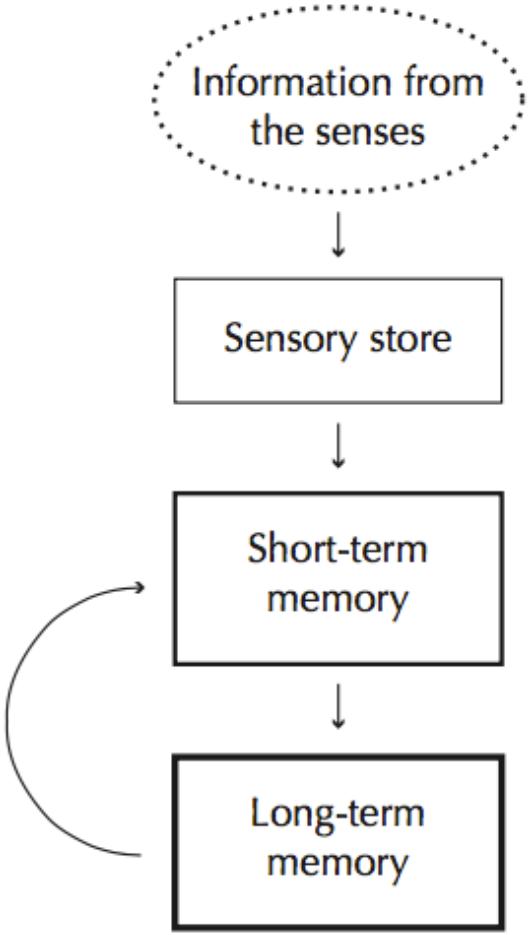
- The mind is not a black box. It has to be opened and understood
- Progresses in cognitive psychology influence learning theories (= mind process theory)
  - hypotheses on the mind structures to explain observable behavior
- Learning changes brain's structure
  - how are these structures made?
  - qhich processes have to be activated to favor learning?

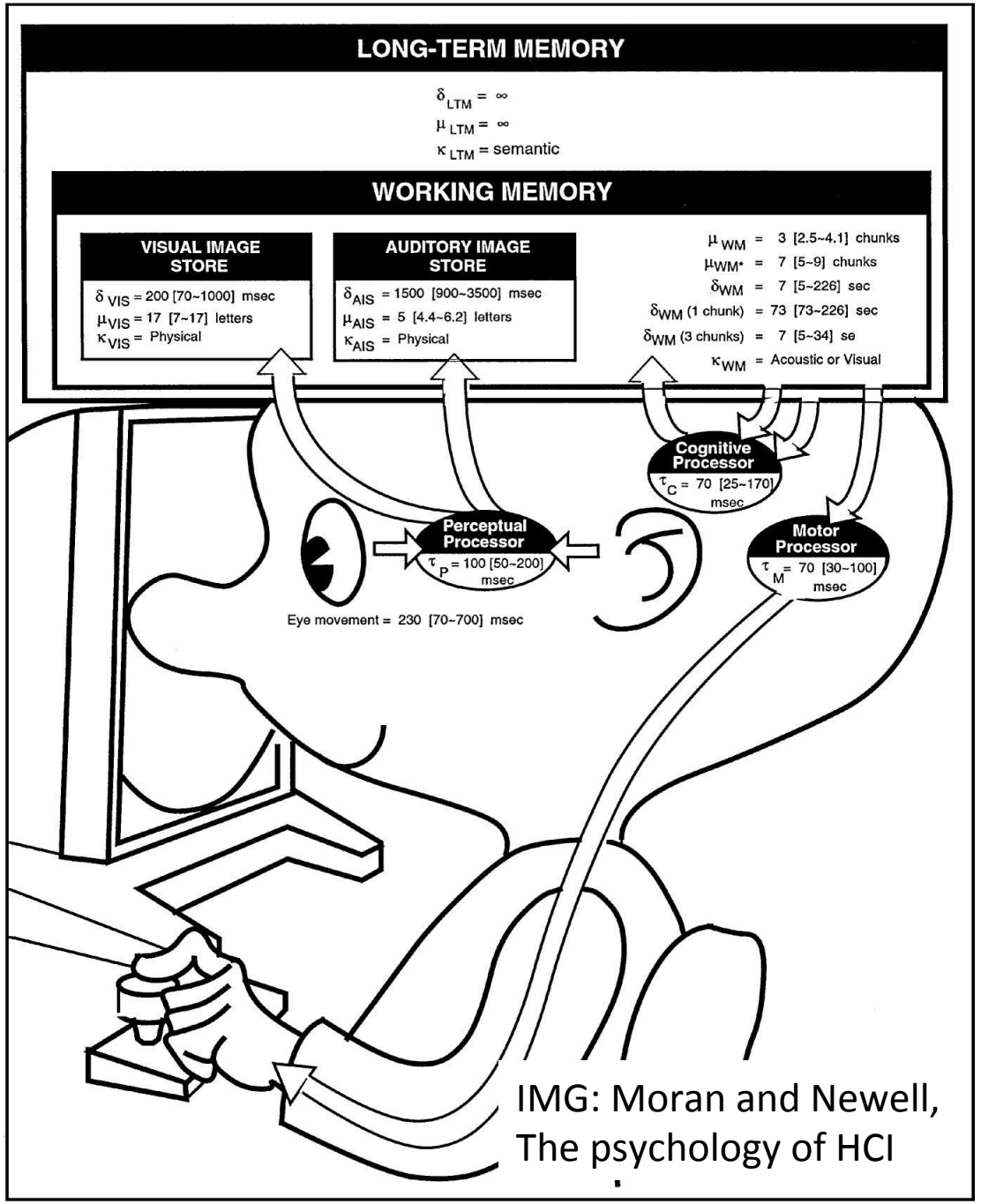
Cognitivism

- Computational model of the mind
- The mind is an information processor
  - collects information though senses
  - Transforms information
  - Memorizes information
  - Recollects information
  - Generates answers

- Learning changes memory structure

Computational model of the mind





IMG: Moran and Newell, The psychology of HCI

Short term memory

https://en.wikipedia.org/wiki/Short-term_memory

The limited duration of short-term memory (~18 seconds without a form of memory rehearsal quickly suggests that its contents spontaneously decay over time. Rehearsal is the process where information is kept in short-term memory by mentally repeating it.

George Miller suggested that human short-term memory has a forward memory span of approximately seven items plus or minus two.

Chinking is the process by which one can expand his/her ability to remember things in the short term.

Implications for the learning environment

- Information must be presented so as to:
  - activate pre-existing knowledge
  - motivate the student
  - optimize memory effect
- Student is at the center of the learning process. Must be able to:
  - choose the learning path and adapt it to her(*) pre-existing knowledge
  - experiment (explore material, adapt it to pre-existing knowledge)
  - find information by herself – evaluate, structure, reorder, rearrange them, generate her own conclusions, derive general rules which allow her to receive new problems
  - get personalized help

* short for his/her

Implications for the learning environment

- teacher becomes a "facilitator"
- main objective of the learning: acquire ability to solve problems

Main ideas

- Learning involves the use of memory, motivation, and thinking.
- Reflection plays an important part in learning
- Learning as an internal process. The learned amount depends on:
  - the processing capacity of the learner,
  - the amount of effort expended during the learning process,
  - the depth of the processing
  - the learner's existing knowledge structure

Intelligent Tutoring System (ITS)

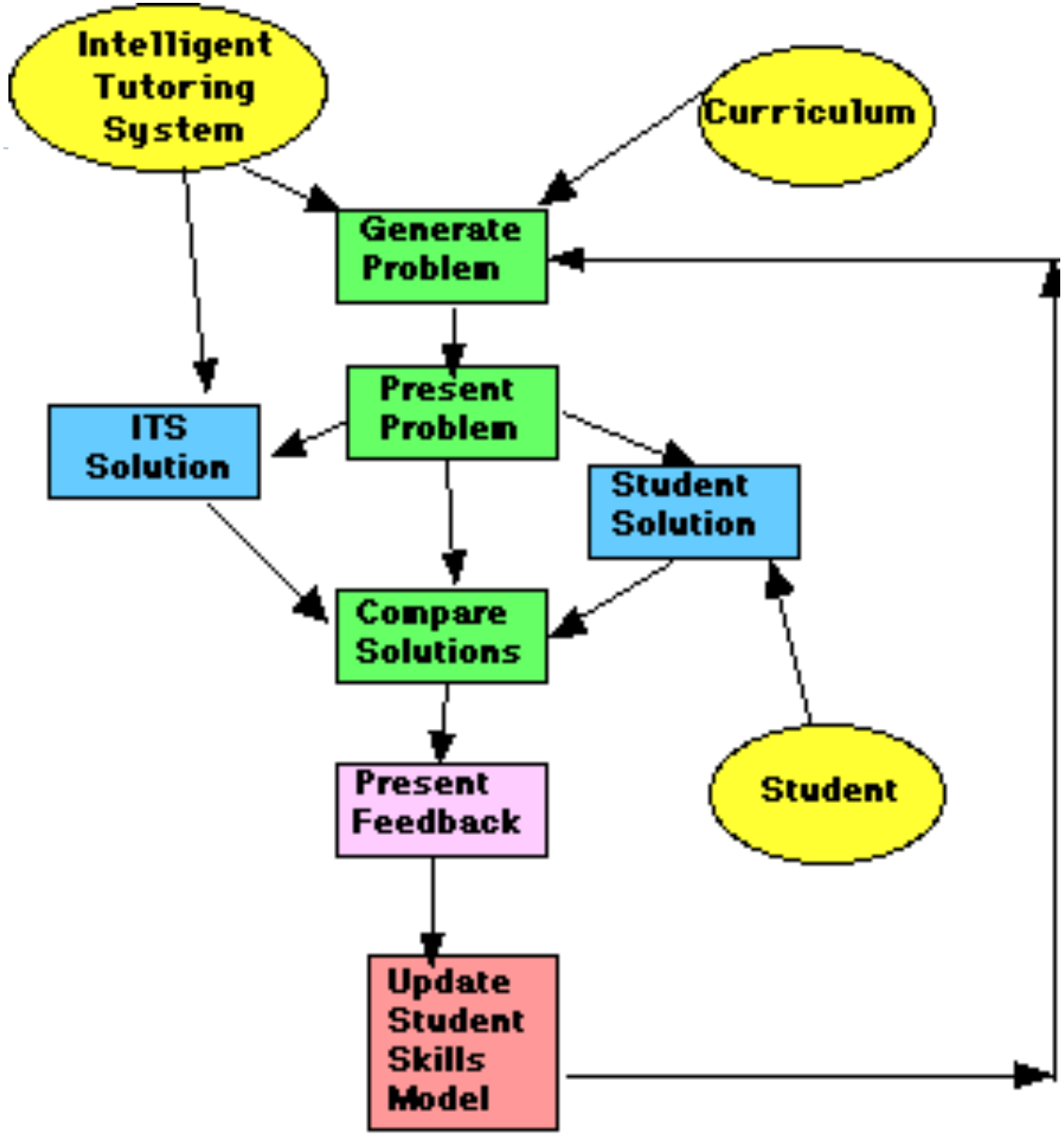
- Artificial intelligence as teacher replacement

- Intelligent Tutoring System: the "perfect teacher"
  - Chooses the right material
  - Chooses the optimal presentation
  - Choses the best sequence, based onto the progresses

- Adaptive system
  - modifies its behaviour according to the students' performances
- Fundamental ingredient: students model
- knowledge, competence, preferences, objectives…

ITS

The model



Negative aspects

- too little attention to the social and motivational aspects of learning
- too much emphasis on A.I.
- expensive systems
- Effectiveness not yes demonstrated, except for closed and well formalized domains
- Research is active since the '60ies, and still visionary!

Positive aspects

- Rich aspects, which offer opportunities for:

- adaptation to formative path
- explorations (e.g. simulations)
- meta-knowledge

Meta-knowledge

- Objective: being aware of one's own learning process, and of the best conditions for making it happen
- knowledge of the "self"
- knowledge of the task to be performed
- Cognitive strategies to solve problems

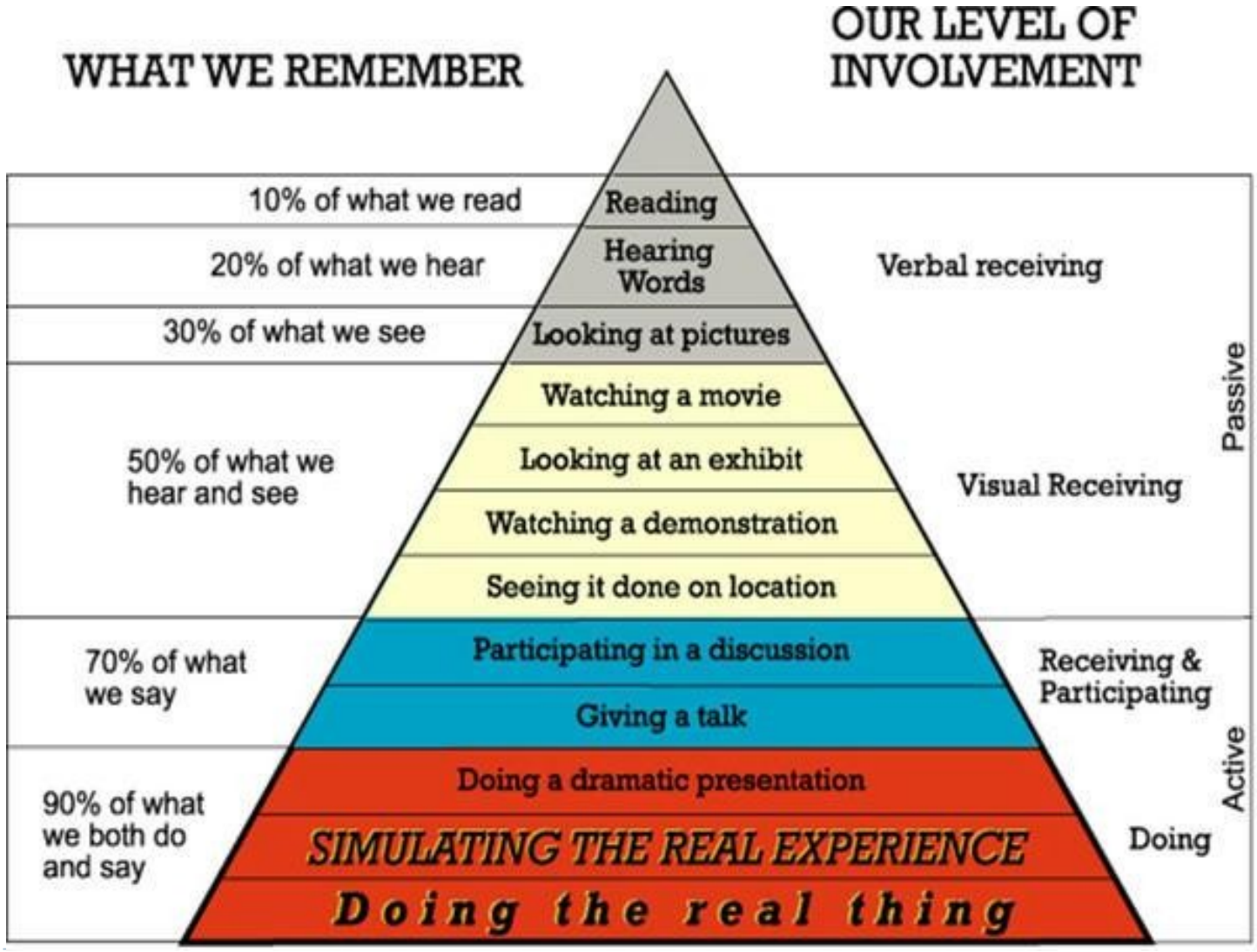
- Feedback must be a meta-learning tool, rather than an evaluation tool
  - Planning objectives, reflection on results, comparison between plan and results

Costructivism

- Learning is an active and situated process
- Learning aims at building rather than acquiring knowledge
- Knowledge construction is based on personal experience, and observation of the environment
- people actively build their own subjective representation of the objective reality.
- People continuously test their hypotheses through social negotiation
  - communication is important!
- New information is linked to preexisting one
- All situations generate knowledge

- Radical interpretation: knowledge can not be thought!

The Pyramid of Constructivism



The learning process

- Active, self-managed, constructive, situated, social

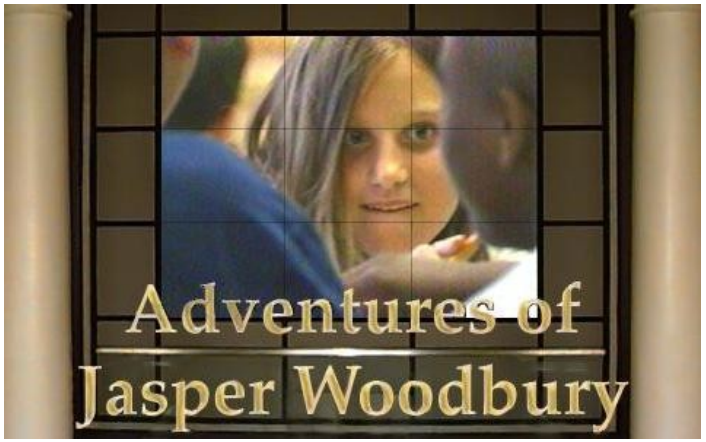
- Requires;
  - Interest and intrinsic motivation
  - Guidance and orientation
  - Linking with pre-existing knowledge
  - Opportunity for sharing and reflect
- The teacher is:
  - a coach: he starts the natural learning process, activates and promotes meta-learning
  - Designer of the learning space, which is student-centric and rich of problem-solving opportunities
  - Domain expert
  - Moderator: asks questions, keeps the process alive

Implications for the learning environment

- Authentic
  - complexity, adherence to reality
  - context which is familiar for the student
- Different perspectives
  - Stimulate competence transfer between domains
  - concept associations
- Social context
  - knowledge validation, communities of practice
- Externalization and reflection
  - generalization and abstraction starting from concrete situations
  - Problem solving competences

Learning environment

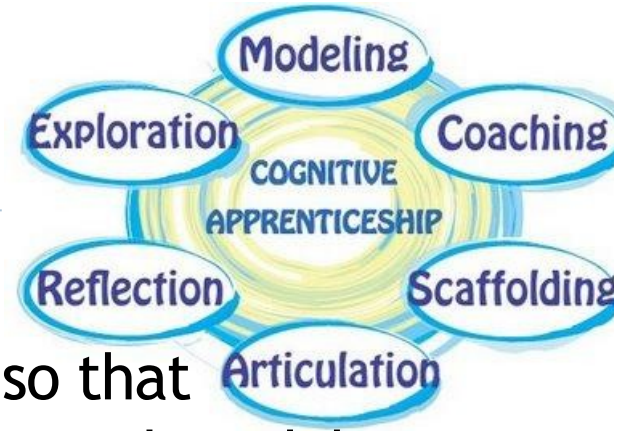
- Anchored Instruction: Technique to situate a technique in a series of real life contexts to stimulate reflection , transfer to other contexts and the ability to solve complex and realistic problems
- videos are "anchors" or macro contexts.
- teaching activities are designed around the anchor, and are presented as cases to be solved.



- An example is the famous series adventures of Jasper Woodbury

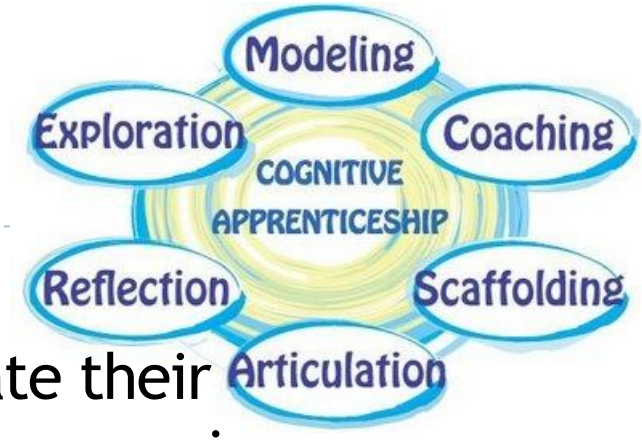
https://www.youtube.com/watch?v=C6OGFkOcttI

Cognitive Apprenticeship Model



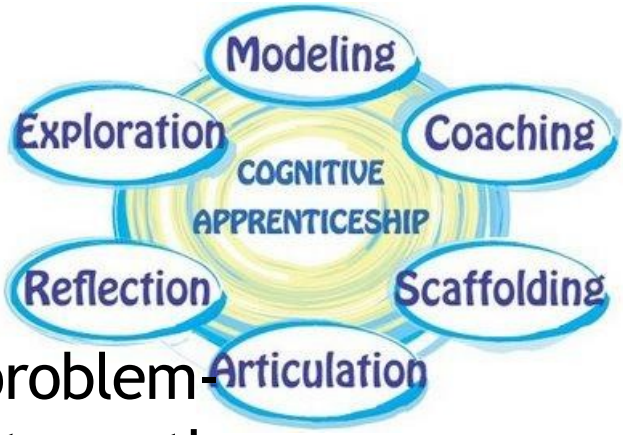
- Modeling
  - an expert demonstrates a task explicitly so that novices can experience and build a conceptual model of the task at hand.
- Coaching
  - An expert observes a novice task and offers feedback and hints to improve the novice's performance to that of an expert.
- Scaffolding
  - putting into place strategies and methods to support the student's learning. These supports can be teaching manipulatives, activities, and group work. The teacher may have to execute parts of the task that the student is not yet able to do.

Cognitive Apprenticeship Model



- Articulation
- "any method of getting students to articulate their knowledge, reasoning, or problem-solving process in a domain
  - inquiry teaching: Teachers ask students a series of questions that allows them to refine and restate their learned knowledge and to form explicit conceptual models.
  - Thinking aloud: students articulate their thoughts while solving problems.
  - Critical student role: Students assume a critical role monitor others in cooperative activities.

Cognitive Apprenticeship Model



- Reflection
  - allows students to "compare their own problem-solving processes with those of an expert, another student, and ultimately, an internal cognitive model of expertise".
- Exploration
  - gives students room to problem solve on their own and teaches students exploration strategies. The former requires the teacher to slowly withdraw the use of supports and scaffolds. The latter requires the teacher to show students how to explore, research, and develop hypotheses.

    Exploration allows the student to frame interesting problems within the domain for themselves and then take the initiative to solve them.

Learning phases

Student

Expert

Modeling

passive

active

Student observes the expert when the expert solves a complex problem. The expert makes explicit the main process steps.

The student solves simple tasks by emulation. Example, complete a problems solution outlined by the expert, closely supported by the expert, who gives feedback on the problem solving process

The expert gradually disappeears while the task complexity increases.

Scaffolding
Coaching
Articulation

active

passive

the student reflects autonomously on her on problem solving strategy.
The student discusses her own strategy with her peers.

Reflection
Exploration

Main ideas

- Learners interpret the information and the world according to their personal reality, that they learn by observation, processing, and interpretation, and then personalize the information into personal knowledge
-
- Learners learn best when they can contextualize what they learn for immediate application and personal meaning.

Critical aspects

- The philosophy of learning as individual construction is not to be interpreted as arbitrary knowledge acquisition
  - not all mental models are equal, as far as correctness, adequacy, common sense, relevance are concerned
  - mental models have to be validated via predefined solutions, discussions, group evaluations…
- the delegation of control to the student requires new competences: motivation, reflexion, organization capability…
- Time and effort

Connectivism

Siemens (2004)
integration of principles explored by chaos, network, complexity and self-organization theories.

Due to the information explosion in the current age, learning is not under the control of the learner. Changing environments, innovations, changes in the discipline and in related disciplines all suggest that learners have to unlearn what they have learned in the past, and learn how to learn and evaluate new information.

Some knowledge will reside in machines while some will reside in humans. The challenge for educators is how to design instruction for both machines and humans, and how the two can interact with each other.

Implications of the formative project

Behaviourism	Cognitivism	Constructivism
Decomposition of the learning material in small units, proposed in a sequence Clear objectives for every teaching unit Self-evaluation Immediate feedback and tangible reward	Use feedback to guide the student. Creation of accurate mental maps Connection between practice and theory Creation of new situations to promote knowledge transfer	Instructional design = creation of complex, authentic, contextualized, transferable learning opportunities Very limited external control of the student

So, what is important?

- Behaviorism
  - to structure the material in learning objects with explicit learning objectives
  - To allow practice and self-evaluation
- Cognitivism
  - To have students build good mind maps
  - to favor knowledge transfer to other domains
  - to be able to solve problems
  - to enable metalearning
- Constructivism
  - The problem solving strategy (not the result)
  - To have opportunities to reflect and externalize
  - To learn from experts
  - To have a good motivation
  - The social aspect of learning

Comparison of theories suitability

Behaviorists' strategies can be used to teach the *what* (facts);

cognitive strategies can be used to teach the *how* (processes and principles);

constructivist strategies can be used to teach the *why* (higher-level thinking that promotes personal meaning, and situated and contextual learning).