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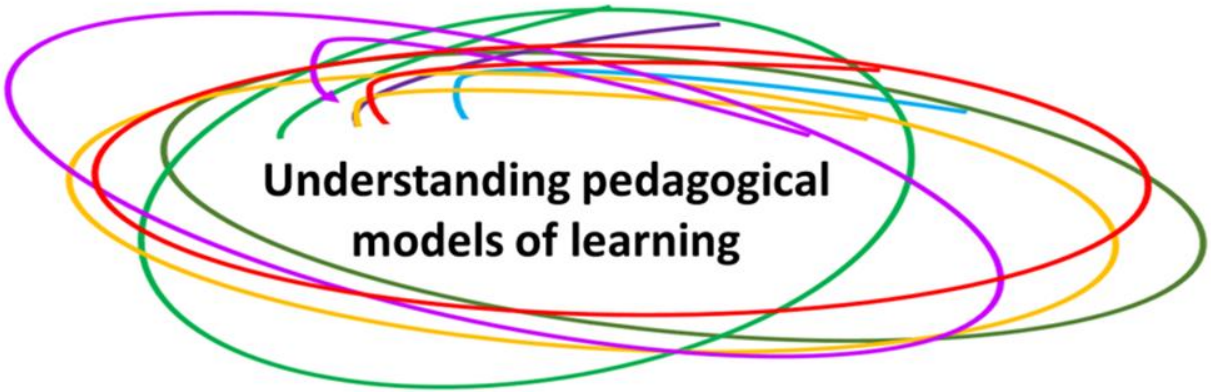

Understanding pedagogical models of learning

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Introduction

The competency-based approach is the major educational objective of teaching in the License Master Doctorate (LMD) system. However, this approach by competence is very difficult to understand, to the extent that the notion of competence, in itself, is already an abstract notion which has multiple definitions. This approach is the result of an evolution of educational models, which over the past century has developed by moving from a transmissive pedagogy (also called encyclopedist), which had been in force for several centuries, to a behaviorist pedagogy, to arrive to a social constructivist pedagogy.

But what do these different educational models represent, and above all mean? This is the purpose of this brochure which will allow us to better understand the evolution of these models, and especially how to adapt our teaching to the new teaching needs, imposed by the introduction of the LMD system.

One of the main characteristics in higher education for the recruitment of teachers is the possession of a diploma in the specialty to be taught. However, the study of the teaching or communication skills of the future teacher is not given due consideration during their recruitment. Although in recent years a few popularization sessions have been offered to new teachers, most other teachers have only learned the teaching profession through experience, without any prior training in pedagogy. In the classic teaching system (classical compared to the LMD system), the main teaching model was, and still is, the transmissive model, while it adapts very poorly to new needs, dictated by the socio-economic evolution of our country, and also by the new teaching approach (LMD system). This 21st century is characterized by what some are already calling ‘the digital revolution’. At the level of the Ministry of Higher Education and Scientific Research, significant investments have been made to avoid a significant digital divide, which could have negative consequences for the future of our universities. However, in addition to these significant material resources, training should be added in order to make these investments profitable.

The purpose of this brochure is to present for any teacher, or future teacher, essential educational support, which summarizes the information they must know in pedagogy, in order to be able to find their way in teaching, according to their own intellectual skills.

We have divided the following into two parts. The first, the most important, presents the evolution of the main educational models. The second, a presentation of the evolution of the software, as a significant tool for the teacher.

1. Educational learning models

In what follows, we will successively present the main pedagogical models[1] of learning: behaviorist, neo-behaviorism, the gestalt model, the model centered on information processing, constructivism, pedagogical cognitivism, neo-cognitivism , then the pedagogy of mastery.

To each of these models, we will associate their main authors (with a very brief bibliography), the main definitions of the concepts associated with the model, the type of learning, the main ideas to remember from the model, then an illustration in terms of training remotely and use of information technologies.

1. 1. Behaviorisme

1. 1. 1. Associated authors

Ivan Pavlov (1849-1936) Russian physician and physiologist (Nobel Prize in 1904). He studied conditioned reflexes and highlighted that of responsive or classical conditioning. His work is part of the evolutionary perspective, based on animal experimentation. He bases his approach both on the associationist model and on the study of reflexes. His work has had a profound and lasting influence on the science of mind and behavior. His discovery of classical conditioning helped establish the school of thought known as behaviorism. Through the work of behavioral thinkers such as Watson and Skinner, behaviorism became a dominant force within psychology during the early half of the 20th century.

[1] Model and method should not be confused. The model is about the why, while the method is about the how.

Hermann Ebbinghaus (1850-1909) was a German psychologist. He applied experimental methods to areas other than those of sensation, and in particular to those of memory and learning. He is the first to have set up experimental paradigms for the study of memory, that is to say typical situations used in experimentation to study a problem. It will remove the syntax and replace these texts with lists of words. It will then remove the meaningful content to arrive at simple meaningless syllables (paralogues). It thus establishes 2300 syllables of the consonant/vowel/consonant (CVC) type such as TUT, POL, BAT, TIC, etc.

Edward Lee Thorndike (1874-1949) was an American psychologist, precursor of behaviorism. He is particularly known for his research on animal intelligence and educational psychology. It creates a learning situation with problem boxes, a device in which an animal is locked and from which it can only escape by carrying out a specific manipulation, which it must discover by groping, hence the name 'learning by trial and error, this type of learning. His work represents the first systematic attempt to identify the fundamental laws of learning within the framework of scientific psychology, and very strongly marked the first half of the 20th century by the essentially experimental nature of his approach.

John Broadus WATSON (1878-1958) was an American psychologist. He wanted to make psychology an objective science and founded behaviorism. For him, the object of psychology is the rigorous study of observable behavior, the response to a defined stimulus, introspection is excluded. He considers the objects of this science to be the study of the stimulus-response couple and adaptation to a specific situation. According to Watson, all behaviors are the result of learning (conditioning). He conducts research on children's behavior. Under his leadership, the name behaviorism was born (1913: behaviorist manifesto). At the same time as Watson's behaviorism, another stream of research proposed alternative theories: Gestaltism.

Burrhus Frederic Skinner (1904-1990) was an American psychologist and thinker. Founder of radical behaviorism, he was strongly influenced by the work of Ivan Pavlov and that of the first behaviorist John Watson. He deepened the requirement, stated by Ebbinghaus, by insisting on the fact that the study of psychological processes could only be done through the objective observation of the behaviors manifested by the individual. He has been voted by his peers as one of the most important psychologists of the 20th century and also as one of the most influential scientists of this century.

1. 1. 2. Definitions of concepts associated with the model

- Association.

The notion of association, introduced by H. Ebbinghaus, explains that during his observations, which focused on the memorization of syllables, relearning is much easier when the syllables are placed in the same order as during initial learning. "During the first learning, a direct association was created between the immediately contiguous terms in the series. The strength of this direct association is relatively high since it results in an economy (a reduction in the time devoted to relearning by compared to the time spent on initial learning) important in terms of relearning the same syllables, placed in the same order, the following day."

- Law of effect.

Law formulated by E. L. Thordnike which describes the connection between a situation and its response. A connection is strengthened or weakened by the effect of its consequences. If the situation-response connection is followed by a state of satisfaction of the subject (reward) it is reinforced; if it is followed by an unsatisfactory state (punishment) it is weakened.

- Responsive packaging.

When the presentation, for a long period of the conditional stimulus alone, leads to the disappearance of the response (extinction phenomenon) and it is possible to establish chain conditioning by associating, with a first conditional stimulus, a second, then a third, etc., this is classical conditioning or also called respondent conditioning. Thus, the procedure consists of constructing new behaviors through the establishment of a link between a stimulus and a response thanks to the intervention of a reinforcing agent.

- Law of Exercise.

The connections between a situation and its response are strengthened by exercise and weakened when exercise is stopped. Strengthening the connections between a situation (the cage the animal is in) and the response (the correct manipulation of the latch) leads to an increase in the frequency of occurrence of the correct response.

1. 1. 3. Type of learning

- Learning by trial and error.

For learning to take place, it is essential that the animal is active. Initially, he proceeds with a series of unsuccessful attempts, then his conduct is subsequently refined to gradually eliminate the least effective behaviors and arrive at a solution more and more quickly. Thus, practices are repeated, reinforced and the error fully participates in learning by reducing the probability of appearance of the behavior which caused it.

- Learning by association.

H. Ebbinghaus uses the notion of association to explain that relearning is much easier after initial learning. In the latter, a direct association is created between the different acts of the animal (object of the experiment). The strength of this association results in a significant saving of time when relearning

the same action. For I. Pavlov, it is the repeated presentation of a neutral stimulus with an unconditional stimulus, in order to establish a conditional reaction, to the sole presentation of the neutral stimulus. Respondent conditioning is the basis of association learning.

1. 1. 4. Main ideas to remember from this model

- Learning is:

    - Identify the different associations of a phenomenon,

    - Do exercises with precise and detailed notes,

    - Solve problems by noticing an appropriate solution after several tries,

    - Listen, watch, react and try to reproduce,

    - Produce behavior adapted to the environment,

    - Find the right solution (without taking into account whether it was understood or not),

    - Be rather passive and use habits in response mode,

    - Assimilate new information.

Thus, learning is the acquisition of a new behavior following particular training. It is the process by which an individual tries to adapt to the changing external world by first identifying the different associations of a phenomenon, during initial learning, and then using them in further training.

- Teaching is:

    - Change observable behaviors and promote the cognitive development of the learner by using positive reinforcements (reward) or negative reinforcements (punishment),

- Break down a skill into its elementary components. Thus, the written addition of two two-digit numbers involves the mastery of a certain number of sub-skills such as correctly aligning the numbers in columns, adding two single-digit numbers digit, carry out the transfer to the tenth... To master the written addition of two two-digit numbers, it is essential to master each of these sub-skills, but also to be able to put them into practice.

- Establish a progression, going from simple to complex,

- Design the course content and exercises according to this progression,

- Practice structural exercises.

- The role of the teacher is to:

- Condition the learner through a set of associative operations through which he manages to provoke new behavior in him,

- Define sub-objectives and practice progressive exercises allowing you to complete the different stages without difficulty,

- Redistribute the knowledge it holds, it is a transmitter of information,

- Present, describe, diagram, explain, argue and illustrate knowledge through a course, generally lecture-based,

- Reinforce behaviors positively or negatively,

- Adapt to the needs of the learner,

- Help learners achieve the expected result by leveling out difficulties, guiding the learner and institutionalizing knowledge.

- The role of the learner is:

- Acquire a new behavior following specific training,

- Follow a process to adapt to the outside world, which is changing,

- Practice the exercises proposed by following the marked itinerary step by step, as well as the steps programmed by the teacher,

- Be attentive and obedient to the presentation,

- Listen, look, react, assimilate and try to reproduce.

1. 1. 5. Illustration in terms of distance learning and use of information technologies

- Multiple Choice Questions, without feedback,

- Exercises recorded on a medium (CD, video, etc.) with progressive difficulties.

1.2. Neo behaviorism

1. 2. 1. Associated authors

Clark Leonard Hulla (1884-1952) was an American psychologist. He developed a highly systematized theory of behavior, centered on learning phenomena, and had a great influence on American behaviorism. To experimental psychology, he brought a new method: the systematic hypothetico-deductive method, after observation and the development of hypotheses. This method provides him with precise definitions and conceptualized postulates, which allow him to deduce his theories to be submitted to experimental verification. For him, behavior is a set of interactions between the individual and his

environment. It analyzes behavior from the perspective of biological adaptation which is an optimization of living conditions driven by a sort of reduction of need.

Guthrie Edwin Ray (1886-1959) was an American psychologist and leader of behaviorism, more particularly associationism and S-R theories which are based on the law of contiguity. He challenges certain central ideas of behaviorism by asserting that repetition is not necessary for learning which can take place in a single trial in an all-or-nothing process. The mechanism of learning lies within the individual. . According to him, learning results from the temporal contiguity existing between a behavior and a set of stimuli present at the same time.

Burrhus Frederic Skinner (1904-1990) was an American psychologist and thinker. Founder of radical behaviorism, he was strongly influenced by the work of Ivan Pavlov and that of the first behaviorist John Watson. He deepened the requirement, stated by Ebbinghaus, by insisting on the fact that the study of psychological processes could only be done through the objective observation of the behaviors manifested by the individual. He has been voted by his peers as one of the most important psychologists of the 20th century and also as one of the most influential scientists of this century.

N. Crowder (1959) is a U.S Air Force instructor. He believes that successful step-by-step progression can leave intact faulty modes of reasoning that represent an inadequate or flawed way of organizing information. It is then appropriate to allow the error to manifest itself so that it can then be processed and corrected. He criticizes Skinner's linear programming: errors, he says, are inevitable during instruction, we can even use them if we provide mechanisms to correct them. He proposes the concept of branching programming, also called intrinsic programming. This type of programming makes it possible, from the start of the program, to adapt the instruction to the learner, taking into account individual differences. It offers a teaching machine with connection which allows the learner to access increasingly complex knowledge, as and

when they respond, and by taking them into account. It is a very sophisticated machine that contains rolls of film onto which multiple instruction sequences are attached. Button consoles are connected to it which allow students to answer questions. But for each new lesson, you have to reload the machine, a complex operation, if ever there was one, which seriously limits its ease of use. This machine nevertheless prefigures the first computer-assisted teaching. Thus, N. Crowder managed to define the specificities of a teaching machine capable of presenting information, soliciting the learner's activity through questions, evaluating his response, then guiding him according to the answers provided.

1. 2. 2. Definitions of concepts associated with the model

- Operant conditioning. The object of this procedure consists of constructing new behaviors through the establishment of a link between a stimulus and a response thanks to the intervention of a reinforcing agent. Driving is acquired when the stimulus-response link becomes autonomous.

- Reinforcing agent. The basic principles that govern the acquisition of a new behavior are:

- The delay between the action and the presentation of the reinforcing agent which must be as short as possible (principle of temporal contiguity),

- The nature of the reinforcing agent which must be adapted to the needs of the subject and the presentation of the reinforcing agent which must be seen as a consequence of the action.

Skinner also suggests directly manipulating the reinforcing agents in order to highlight the elements which make it possible to reinforce the robustness of the S-R link. He distinguishes between positive reinforcement and negative reinforcement. Positive reinforcement is such that its presentation increases the frequency of occurrence of the behavior. Negative reinforcement has the effect of increasing the frequency of occurrence of the behavior when it is suppressed.

- Discrimination. When abusive generalizations appear, these can be corrected by discrimination so as to lead the learner to discover what distinguishes the two situations so as to give them different responses.

- Generalization. Generalization occurs when a subject makes a particular response to a particular stimulus and then makes the same response to another stimulus. In principle, the farther the stimulus is from the original stimulus, the weaker the response will be. Generalization can lead to positive or negative effects depending on the context in which it occurs.

- Principle of temporal contiguity. The time between the action and the presentation of the reinforcing agent should be as short as possible.

1. 2. 3. Type of learning

- Learning by operant conditioning/without errors.

- Learning through subject activity. The most appropriate actions are then selected based on the results obtained, so it is learning by result. The courses offered by Skinner are described as linear (linear programmed teaching) in the sense that they require the learner to go through them from start to finish without taking into account the fact that some learners are likely to progress more quickly. For a course to be effective, Skinner estimates that the learner must make fewer than 10% errors. He recommends organizing teaching with a view to minimizing the appearance of errors within the framework of a method (operant conditioning/error-free learning). For him, any behavior, whether psychomotor or cognitive, can be acquired effectively by preventing the learner from making errors.

When abusive generalizations appear, these can be corrected by discrimination so as to lead the learner to discover what distinguishes the two situations so as to give them different responses. Only the correct answer acts as a reinforcing agent.

1. 2. 4. Main ideas to remember from this model

- Learning means breaking down learning into small steps so as to minimize the risk of incorrect responses appearing and to maximize the frequency of presentation of positive reinforcements.

Acquire automatisms, psychomotor or cognitive behaviors.

- Teaching means presenting information, soliciting the student's activity through questions, evaluating the student's response and directing the student in the course based on the answers provided. Learning must be broken down into small steps so as to minimize the risk of incorrect responses appearing and to maximize the frequency of presentation of positive reinforcements, instilling professional behaviors, attitudes, reactions and gestures.

- The role of the teacher is essentially to carefully define the objectives to be achieved and then to transcribe them in sufficiently precise terms so that we can verify that they have really been achieved (operational objectives). Inform the learner of what is expected of him by presenting the objectives that he will have to master at the end of the learning, evaluate the learners' responses and direct his interventions based on the answers provided.

- The role of the learner is to be active, avoid making mistakes and take charge of their evaluation, learn in a controlled manner, by following the steps step by step.

1. 2. 5. Illustration in terms of distance learning and use of information technologies

- Multiple choice question with indications to help you make the correct choice.

- A complete training program, which on a branched type model, generally offers a part of courses and exercises.

- The teaching machines of Skinner and Crowder (computerized presentations).

- Computer-Assisted Teaching (CAE).

- Tutorials.

1. 3. The Gestalt model

1. 3. 1. Associated authors

Max Wertheimer (1880-1943) was a German psychologist, one of the founders of form psychology. He developed a technique based on associations between words and physiological reactions to detect lies from suspects and determine their involvement in a crime. This research seems inspired by the concepts of associationism which dominated German psychology of the time. Ideas that Wertheimer would later develop in the psychology of form. Wertheimer worked on this subject for several years, developing the notion of 'complex' and association techniques. These ideas would later be widely used in psychoanalysis.

Kurt Koffka (1886 - 1941) is a German psychologist, one of the founders of form psychology with Max Wertheimer and Wolfgang Köhler. He has notably devoted his research to developmental psychology and the application of the principles of Gestalt theory to memory. He also contributed to making form psychology known in the United States and published the main synthesis of research in this movement (Principles of Gestalt Psychology in 1935).

Wolfgang Köhler (1887-1967) was a German psychologist and one of the founders of form psychology.

One of Köhler's best-known results is his description of the phenomenon of insight in problem solving in chimpanzees. Köhler describes how the animal stops after several unsuccessful attempts, then seems to suddenly discover a new solution by reorganizing the elements of the problem. This analysis directly opposes the idea of reinforcement learning advocated by behaviorists as a sufficient principle to account for all human or animal behavior. The existence of insight in fact prevents problem solving from being reduced to conditioning.

George Katona (1901-1981) was an American psychologist of Hungarian origin who was one of the

first to advocate a rapprochement between economics and psychologists. Originally trained as a Gestalt psychologist, working on problems of learning and memory, he became involved in the US government's attempts to use psychology to combat inflation. This led him to consider applying psychological principles to macroeconomics, and he devised measures of consumer expectations, which eventually became the University of Michigan Consumer Sentiment Index. Using this index allowed him to predict the postwar boom in the United States at a time when conventional (econometric) indicators were predicting a recession, a success that helped his nascent index establish itself. Katona wrote numerous books and journal articles advocating the development of economic psychology. These general ideas were taken up more in Europe than in the United States, until the development, after his death, of modern behavioral economics.

1. 3. 2. Definitions of concepts associated with the model

- Restructuring process

The subject is not stable, objective, hence a process of transition from one state to another. Experiments have shown that perception is not objective. It depends both on the characteristics of the environment in

which the object is placed and on the expectations of the subject. Another essential characteristic of the stimuli, implemented in a learning situation, is linked to the fact that they are perceived globally as evidenced by different experiments developed by the Gestaltists.

For Gestaltists, these are the forms which constitute the fundamental and indecomposable elements of human activity. The constitution of these forms responds to a certain number of elementary principles, highlighted by the Gestaltists. First of all, a form is more than the sum of its parts. Then, there are strong forms and weak forms depending on the degree of integration of the parts that constitute them. Regular, symmetrical shapes are the strongest. There is a tendency for more complex shapes to evolve towards as simple a structure as possible (principle of good form). Then, other laws define the relationships between different elements of the form: principle of proximity, principle of similarity, principle of closure, etc.

-Insight

Insight learning translates the transition, often brutal, from one state to another which gives rise to a restructuring of the perception of the situation. It is a productive learning (with intervention of insight) which requires a restructuring process of a discontinuous nature.

- Principle of proximity

Elements tend to group together with the closest ones. Nearby items in the visual field tend to be grouped together.

- Closure principle

We tend to organize our perceptions into a good form. To do this we fill in the gaps in the stimuli presented to us.

- Principle of similarity

Elements tend to group together with the most similar ones. We tend to see letters grouped in columns rather than rows.

1. 3. 3. Type of learning

- Reproductive learning (without insight intervention) and productive learning (with insight intervention).

Katona clarifies this differentiation by highlighting that reproductive learning could develop continuously, under the effect of repetition, while productive learning requires a restructuring process with a discontinuous character. The behaviorists were primarily concerned with the first form of learning, the Gestaltists chose to place the emphasis primarily on the second form.

- Learning by insight described by the Gestaltists is opposed to the learning by association of the behaviorists in that it is not based on a process of continuous improvement of behavior, but rather reflects the passage, often brutal, from one state to another which gives rise to a restructuring of the perception of the situation.

1. 3. 4. Main ideas to remember from this model

- Learning is organizing, or reorganizing, certain elements differently, discovering and establishing new relationships between elements which until then were seen as isolated.

- Teaching is guiding the learner to free themselves from the elements they perceive (insight), to organize and restructure them to solve a problem, to set up a learning process of restructuring, of the perception of the situation, in order to move from one state to another.

- The role of the teacher is to explain to the learner how to perceive the elements of a form, and help them to structure reasoning to solve a problem by modifying their internal perception of the form.

- The role of the learner is to be active, to solve problems. It is discovering an appropriate solution by restructuring the elements of the situation.

1. 3. 5. Illustration in terms of distance learning and use of information technologies

- Teaching by video.

- Testing.

- Simulation with business games.

In economics, the 'business game' is an educational tool allowing the discovery and use of knowledge, know-how,

- Educational software.

A computer program relating to computer-assisted teaching (CAE); more precisely, it is interactive software intended for learning knowledge (and more rarely know-how) on a given theme or field and generally including self-monitoring of knowledge.

1. 4. The model centered on information processing

1. 4. 1. Associated authors

George Armitage Miller (1920-2012) is an American professor of psychology since 1979. His research helped found cognitive psychology. He is thus known for having demonstrated that human cognitive capacities for processing information are limited to “seven plus or minus two” elements. George Miller also worked on language.

Jerome Seymour Bruner (1915-2016) is an American psychologist, whose work focuses particularly on educational psychology. Bruner's ideas are based on categorization, or "understanding how man constructs his world", based on the principle that man interprets the world in terms of similarities and differences. For Bruner, social mediation during teaching-learning behaviors (supervision interaction) is exercised in a communicative (dialogical) mode. It introduces two key concepts accounting for the regulatory processes in these supervisory interactions, that of ‘scaffolding’ and ‘format’.

Donald Ray Atkinson (1928–2005) was an American cognitive psychologist and statistician, specializing in the study of thinking and reasoning. We owe him in particular the concept of script. In 1968, with Shiffrin, he proposed 'the model of memory' based on three entities (sensory memory, working memory and long-term memory), through which information will be processed to be stored in memory.

Richard M. Shiffrin (1942) received a BA from Yale in 1964 (mathematics) and a PhD from Stanford in 1968 (experimental and mathematical psychology). In 1989, he founded and became the director of the Indiana University Cognitive Science Program. Professor Shiffrin is an expert in the field of human cognition. He developed and helped establish a general theory of how we retrieve information from memory. He also developed a theory of the interaction of automatic and attentive processes in cognition. These two theories have been of fundamental importance to the field. His research interests include mathematical and computational modeling, empirical research, learning, information processing and research, not forgetting, attention, organization and structure of memory, perception, processing of visual information and control processes in memory.

John R Anderson (1947). The goal of his research is to understand how people organize the knowledge they acquire, from their various experiences, in order to produce intelligent behavior. Anxiety is a very big part of how it's put together, and this has led to an emphasis on what are called "unified theories of cognition." A unified theory is a cognitive architecture that can perform a full range of cognitive tasks in detail. This theory is called ACT-R ACT (Adaptive Thought Control), and takes the form of a computer simulation. In this model, it aims to show how complex knowledge can be constructed on the basis of a connection between procedural knowledge and declarative knowledge.

Alan Baddeley (1934) has a degree in Applied Psychology (University of Cambridge). In 1974, he developed a theory explaining that working memory (WM) would be composed of a Central Administrator (executive system) which allows the sharing of attention and cognitive resources, as well as decision-making relating to transfer in Long-Term Memory of the processed information. Then two 'slave' systems to the first: the Phonological Loop which allows mental self-repetition then the Visuo-Spatial Notebook which allows the coordination of mental imagery and carrying out visuo-spatial tasks.

1. 4. 2. Definitions of concepts associated with the model

- The Atkinson and Shiffrin model.

This model is based on the existence of three entities (sensory registers, working memory and long-term memory) through which information will be processed to be stored in memory. These three entities operate in their own ways that are important to know in order to understand the memorization process and the limitations attached to it.

- Sensory registers.

Stimuli are first processed by sensory registers which filter the information. This filtering function is essential, since it makes it possible to sort among the enormous quantity of stimuli which constantly solicit the sensory organs. The information selected at this level is then transferred to another memory entity (working memory). The lifespan of information within sensory registers is very limited (of the order of a quarter of a second).

- Working memory.

Working memory occurs when we pay attention to a stimulus recorded by sensory memory. In the Atkinson and Shiffrin model, working memory is located at the second level, between sensory memory and long-term memory. It can therefore be stored in long-term memory using self-repetition, maintenance and/or integration. Working memory is a temporary storage area for information (less than 30 seconds), and has a limited capacity (7 + 2 elements) which can be increased by structuring the information. 'Working memory' replaces the old name 'short-term memory' in order to emphasize the elaboration work that takes place during this stage.

According to the theoretical model of Baddeley and Hitch (1974), working memory is divided into three parts: central administrator, phonological loop and visuospatial notebook.

The central administrator manages the two modules simultaneously: the verbal modality (phonological loop) and the visuo-spatial modality (visuo-spatial notebook). The phonological loop allows three items to be maintained in memory. The central administrator, if not busy with another task, can increase the information retention capacity by mental rehearsal.

- Long term memory

The selection of information is placed under the control of the phenomenon of attention, which is strongly influenced by what the subject already knows, that is to say by the information available in

long-term memory. The intervention of prior knowledge in the selection process which takes place at the level of sensory registers explains the fact that we only perceive what we are prepared for (what we expect).

- Procedural memory

Procedural memory is a component of long-term memory. It is called upon when we have to implement motor sequences without thinking about what we are doing, or even more cognitive procedures, such as applying a succession of operations to resolve a situation. Procedural memory, or memory of actions, is more resistant to time than that of facts.

- Semantic or declarative memory

Semantic, or declarative, memory is also a component of long-term memory. It supports the memorization of concepts, contains knowledge of a general nature which is not associated with a specific moment or a particular context.

1. 4. 3. Type of learning

Learning through the process which leads to the integration of new information into memory. This involves getting the subject used to asking a certain number of questions about the material that will be the subject of learning. Distributed learning is generally more effective than concentrating it at a specific time (massed learning). Since representations constitute personal reconstructions of reality, learning is also a personal constructive activity in which the subject's prior knowledge plays an essential role: improving the encoding and structuring of new information in memory.

1. 4. 4. Main ideas to remember from this model

- Learning means promoting learning by acting at the level of the memorization process, reorganizing one's previous conceptual networks to take into account the new knowledge to be integrated.

- Teaching means acting on the subject to improve the strategies that it will implement in order to improve the encoding and structuring of information, acting on the material that is the subject of learning.

- The role of the teacher is to encourage the cognitive process in the learner by acting at the level of the subject and at the level of the learning materials, and to facilitate the work of the learner by processing the information.

- The role of the learner is to acquire each element of knowledge, but also to be able to implement the appropriate skills, depending on the situation he will have to deal with, to study regularly, and not to concentrate his study the day before the check.

1. 4. 5. Illustration in terms of distance learning and use of information technologies

- Conceptual maps (concept mapping): this involves training the subject to spatially organize information relating to conceptual content, drawing inspiration from the organization of semantic networks. For this, he can use different software developed for this purpose.

- Elements of visual emphasis: it is often possible to help the subject to identify important elements, to establish the links between different elements, or to focus their attention by varying the fonts (size, bold, italic, etc.), by framing certain parts of the text, by structuring the text into titles and subtitles…

- Mathemagenic variables: they designate all the elements introduced into learning material to facilitate assimilation. This type of variable includes previous structuring elements such as objectives, questions

asked before learning, recall of prerequisites or even later structuring elements such as summaries, generalization or broadening of what has been learned.

- Flowcharts: they allow you to graphically represent the progress of a process. The construction of a flowchart uses different geometric shapes to represent the different stages of the process: carrying out processing, making a decision, etc.

- Hypermedia software.

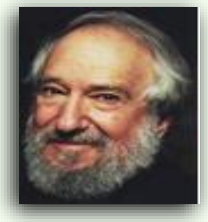
Working memory is involved in all types of cognitive tasks and therefore by extension in learning, distance learning, ICT, etc. It therefore finds application in all types of fields and software.

1. 5. Constructivism

1. 5. 1. Associated authors

William Fritz Piaget, (1896-1980), was a Swiss psychologist, biologist, logician and epistemologist, known for his work in developmental psychology and epistemology with what he called genetic epistemology. His work in genetic psychology and epistemology aims to answer the fundamental question of the construction of knowledge. Through the various researches that he carried out by studying the child's logic, he was able to highlight, on the one hand, that it is built gradually, following its own laws, and on the other hand , that it evolves throughout life, passing through different characteristic stages, before reaching the adult level. Piaget's essential contribution to knowledge was to show that the child has specific modes of thought which entirely distinguish him from the adult. Piaget's work is disseminated throughout the world and continues to inspire, even today, work in fields as varied as psychology, sociology, education, epistemology, economics and law.

Seymour Papert (1928-2016) was a mathematician, computer scientist, and educator at the Massachusetts Institute of Technology (MIT). He is one of the pioneers of artificial intelligence, as well as one of the creators of the logo language. He developed an original theory of learning, called constructionism, which was based on Piaget's theory of constructivism and was to have great influence. Papert also became widely known for his focus on the impact of new technologies on learning in general, and educational institutions in particular.



Allan M. Collins (1937-) is a professor emeritus of education and social policy at Northwestern University. He is a specialist in cognitive sciences. He has studied teaching and learning for over 30 years and has written extensively on related subjects.

He is best known in psychology for his work on how people answer questions, in artificial intelligence for his work on reasoning and intelligent tutoring systems, and in education for his work on situated learning, inquiry teaching, design research and cognitive learning.

1. 5. 2. Definitions of concepts associated with the model

- Accommodation

When the object, or the situation, resists, the accommodation mechanism intervenes by causing a modification of the individual's reception structure so as to allow the incorporation of the elements which are the subject of learning. In this case, the subject is transformed by his environment.

- Assimilation

Assimilation is the incorporation of an object or a situation into the subject's host structure (assimilation structure) without modifying this structure, but with progressive transformation of the object or situation

to assimilate. The subject transforms the elements coming from his environment, to be able to incorporate them into his host structure.

- Sheme

Piaget describes a schema as “a gestalt that has a history” meaning that, unlike ‘good forms’, schemas are acquired structures. In his research in genetic epistemology, Piaget studied the modalities of development of operational schemes, that is to say structures which guide thought and reasoning. This work led him to highlight different stages in the cognitive development of the individual, the main ones of which are: the sensorimotor stage, the preoperative stage, the stage of concrete operations, and the stage of formal operations.

- Mediator

In human and societal relations, the mediator is either a social, institutional or professional activity or a profession in the private domain.

- Socio-cognitive conflict

Sociocognitive conflict is a developmental driver in psychologist Lev Vygotsky's theory. Appearing around 7-8 years old, socio-cognitive conflict is the confrontation of a problem between several children. It is educational to the extent that it allows the child to become aware of the point of view of others and to reformulate their own. After taking a step back from the problem, the child will build his mind by gauging which of the solutions is the most appropriate.

1. 5. 3. Type of learning

- Learning by construction process. It is the result of an interaction between the subject and his environment. The subject confronted with stimuli in a given situation will activate a certain number of cognitive structures to process these stimuli.

- Learning through active teaching practices. The cognitive development of the learner develops through the continuous interaction between, on the one hand, the cognitive structure which characterizes him and his action on the environment and, on the other hand, the information he receives in return from this environment. (difficulty, errors, success, resistance, etc.). Each action on the environment thus causes a cognitive modification which in turn will modify the next action on the environment. It is therefore from the information drawn from action in the environment that the learner will construct his new knowledge.

- Learning by assimilation and accommodation.

1. 4. 5. Main ideas to remember from this model

- Learning is the result of a dynamic process of seeking balance, between the subject and his environment, through assimilation and accommodation, confronting, or being confronted, with new situations in order to create interactions conducive to cognitive development.

- Teaching means confronting the learner with rich and diverse situations in order to create interactions conducive to cognitive development. However, Piaget emphasizes that cognitive development is essentially spontaneous, and that therefore, there is no interest in wanting to accelerate development beyond certain limits, and above all adapting one's teaching to the cognitive development of one's learners.

- The role of the teacher is to facilitate the learner's work by transmitting certain knowledge (such as factual information, or even certain rules and certain basic principles).

- The role of the learner is to overcome the cognitive conflict to arrive at a new form of balance, corresponding to real progress in terms of cognitive development, which is measured in particular by progression within the stages (or sub-stages) of development, construct new knowledge on the basis of previous knowledge and in interaction with its environment.

1. 5. 5. Illustration in terms of distance learning and use of information technologies

- Simulation. Simulator.

Seymour Papert believes that the use of computers makes it possible to concretize the formal domain through the use of learning environments which confront the learner with concrete problems, close to those they would encounter in a real situation. By placing the learner in simulated situations, it is possible to approach complex problems intuitively and to move on to formalization later when the learner has sufficiently mastered the necessary tools.

- Problem situation.

The problem that then arises for the teacher is that of assessing the difficulty proposed. For some learners, the situation turns out to be one of execution. For others, the situation remains a problem, and the trainer must introduce a sufficient level of guidance to orient the learner, until the situation becomes for him one of execution (guidance, guardianship, mediation).

- Educational software based on hypermedia.

From a social constructivist perspective, for example, this type of software should allow learners to adapt their learning at their own pace, according to their representation of the situation of what they already know.

1. 6. Educational cognitivism

1. 6. 1. Associated authors

Jerome Seymour Bruner (1915-2016) is an American psychologist, whose work focuses particularly on educational psychology. He was one of the first discoverers of Vygotsky's 'Thought and Language', and was informed by the work of Piaget and Meyerson. Bruner's ideas are based on categorization, or "understanding how man constructs his world", based on the principle that man interprets the world in terms of similarities and differences. He is considered one of the pioneers of what is called the cognitive revolution in the 1950s. He puts forward the idea of a psychology that reintegrates the mind into the explanation of behavior. For him, the meaning of things is not constructed in the brain, but is given by culture, he strongly criticizes the metaphor of the computer, resulting from theories of information processing and artificial intelligence. The meaning precedes the message, it pre-exists. How does the computer process words that have multiple meanings? The symbolic system that we will use to construct meaning is in place before us, in the culture.

David Paul Ausube (1918-2008) is an American psychologist and disciple of J. Piaget. One of his most important contributions to the field of educational psychology, cognitive science, and learning science teaching has been the development and research on advanced organizers (since 1960). He retired from his academy in 1973 and devoted himself to his psychiatric practice.

Lawrence Weinstein is a professor of physics at Pld Dominion University and a researcher at the Thomas Jefferson National Acceleration Center. His research focuses on electron scattering to study the structure of the nucleus and proton. Among his many awards, Professor Weinstein received the ODU Teaching with Technology Award, was named a University Professor for Outstanding Teaching, and received the A. Rufus Tonelson Faculty Award at ODU, the George B. Pegram Award for Excellence in physics education in the southeast. of the American Physical Society and the Virginia Outstanding Faculty Award. In recognition of his research, Professor Weinstein was named a Distinguished Scholar, a distinction reserved for only 4 percent of ODU faculty members, and a Fellow of the American Physical Society.

Mayer E. Richard (1947-) is an American cognitive psychologist, specializing in the development of educational applications. He has contributed significantly to theories of cognition and learning, particularly as they relate to problem solving, and the design of educational multimedia materials. His best-known contribution to the field of education is multimedia learning theory, which posits that optimal learning occurs when visual and verbal materials are presented simultaneously.

1. 6. 2. Definitions of concepts associated with the model

- Shoring

The learner must be guided during learning. This guidance can be provided by the teacher, but also by other learners, or even by a computer device. The important thing is that a close dialogue takes place, thanks to which the learner will be supported in the difficulties he will have to overcome to resolve the problem posed to him. Bruner will subsequently use the term ‘scaffolding’ to designate this support provided to the student during learning.

- Structuring

For meaningful learning, Ausubel suggests using various elements that will help structure the learning material. Among these elements, Ausubel places great emphasis on the role of 'previous structuring agents'. These are short texts, diagrams or graphics, generally presented at the start of learning, which will facilitate the connection between the elements that will be the subject of learning, as well as the link with the elements already mastered. , available in the cognitive structure of the individual. Alongside the previous structuring agents, it also underlines the role of another form of structuring agents: comparative structuring agents. These have the essential function of leading the learner to establish links between different parts of the learning material offered by using cross tables, tree graphs, etc.

- Anchoring

Anchoring is a process that unconsciously and automatically associates an internal reaction with an external stimulus. We memorize these links and thus create what are called 'anchors'. As soon as an anchor is stimulated, the sensation experienced in the past returns instantly. Anchors can be visual, auditory, kinesthetic, olfactory or gustatory.

- Progressive differentiation

Another important principle for learning is that of progressive differentiation. We first present the general ideas related to the content we want to teach and then we establish more precise differences.

- Cognitive strategy

The notion of cognitive strategy is a corollary of the fact that cognitive psychology considers the subject as an active participant in the teaching-learning process. To deploy this activity, he will implement what we have come to call cognitive learning strategies or simply learning strategies.

- Metacognitive strategy

Another learning strategy leads to highlighting a form that we have come to call metacognitive. Faced with a learning task, we consider that the subject will use both cognitive strategies, such as strategies which will facilitate the encoding of information in memory, but also focused metacognitive strategies, for example , on the active control of the implementation of the operations the subject should carry out to achieve this encoding. The idea of 'meta', which accompanies the qualifier cognitive, refers to the fact that cognitive strategies will lead to making a judgment, or to regulating the application of cognitive strategies.

- Cognitive educability

One approach, known as cognitive education, postulates that it would be possible, using specific methods, to act on certain cognitive strategies, in order to make subjects more capable of learning, or of solving problems. The main characteristic of the methods proposed within the framework of this approach is to relate to situations that are 'empty of content', that is to say not relating to particular contents such as French, history or mathematics.

Generally speaking, these methods focus not only on cognitive strategies, but also on metacognitive strategies, with emphasis on the control and regulation processes that the subject implements. Regarding cognitive strategies, these programs are mainly interested in general strategies such as activity planning, impulsivity control or information selection.

Cognitive education methods emphasize the role of mediator that the trainer must play by guiding the learner's activity and adjusting the level of difficulty of the situations. Some also involve peer interactions to stimulate cognitive development.

These methods are based on fairly limited theoretical support. The effects of cognitive education have been the subject of little evaluation work. The available results show, however, that these programs have a moderate positive effect on the results of certain intelligence tests, which assess abilities close to those exercised in these programs.

- Prior concept

The terms used to designate learners' conceptions are very varied. The authors refer to these conceptions by designating them by expressions such as: prior or alternative conceptions, spontaneous reasoning, children's science, intuitive concepts, pre-representation, preconceptions or even erroneous conceptions. The use of these expressions depends on the author's perspective in relation, on the one hand, to the validity of the learners' conceptions and, on the other hand, to the way in which he conceptualizes the learning process. Thus, an author who attributes a minor status to learners' conceptions, that is to say who considers them accidental, or avoidable, imperfect or erroneous, will readily qualify them as erroneous conceptions (misconceptions). On the other hand, authors who consider that learners' conceptions present only qualitative differences, compared to scientific concepts, and that they therefore essentially influence the way in which learners incorporate, into their cognitive structures, what is expected of them. they learn, will most often designate them by expressions such as alternative, intuitive or spontaneous conceptions. The reference to alternative conceptions further highlights the fact that these conceptions are used in place of scientific conceptions, that is to say that they function for learners as an alternative to the conceptions accepted by scientists whereas the The expression prior conception that we will use in the remainder of this paragraph is more encompassing and avoids any a priori judgment in relation to the relevance of these conceptions.

- Pre-design and Pre-representation

The terms pre-representations or preconceptions emphasize the fact that learners' conceptions are considered as primitive forms of understanding phenomena, which are easily modifiable by traditional teaching strategies.

1. 6. 3. Type of learning

- Discovery learning.

It is an alternative approach based on the active discovery by the learner of the principles and concepts to be mastered. For the author, such an approach leads to a double benefit: on the one hand, it allows a deeper mastery of the contents which are the subject of learning, on the other hand, it develops certain thought processes in the student which will subsequently allow him to be more independent in his learning (learning to learn). However, to be effective, discovery learning must meet certain conditions. First of all, the learner must be prepared for this type of learning through the ability to implement certain specific strategies such as: collecting and selecting information, asking questions, identifying relevant variables, testing hypotheses , etc. Then, he must be guided during learning. This guidance can of course be provided by the teacher, but also by other students or even by a computer device. The important thing is that a close dialogue takes place through which the learner will be supported in the difficulties he will have to overcome to resolve the problem posed to him.

- Meaningful learning through reception.

Adaptation to the environment: for Bruner, what is important in teaching is to ensure that content is presented according to the mode of representation that predominates in the learner, at a given moment in their development. In young children, we will use a more intuitive modality based on concrete representations and only move on to a more abstract formalism when the learner is older. From this observation, Bruner draws an educational approach that he will call 'the spiral curriculum', based on the fact that the same notions can be presented to the learner at different times of his schooling, as long as care is taken to use of appropriate representation methods. Teaching is therefore essentially a problem of translation, that is to say of adapting content to the cognitive modalities available to the individual.

1. 6. 4. Main ideas to remember from this model

- Learning means realizing that one's knowledge is little, or not, adequate to deal with a situation, and then going beyond one's initial conceptions to progress towards more relevant knowledge.

- Teaching means ensuring that content is presented according to the mode of representation that predominates among the learner at a given moment in their development. In young children, we will use a more intuitive modality, based on concrete representations, only moving to a more abstract formalism when the learner is older. Teaching is therefore essentially a problem of translation, that is to say of adapting content to the cognitive modalities available to the individual. Help the learner to grasp the structure of the content that they will have to assimilate, so as to be able to highlight the essential ideas and concepts, and to establish links between them.

- The role of the teacher is to guide the learner, establish a close dialogue with him through which the learner will be supported in the difficulties he will have to overcome to resolve the problem posed to him, ensure that the contents are presented according to the mode of representation which dominates in the learner at a given moment of his development

- The role of the learner is to discover the principles and concepts to master, to be the main actor in his own learning.

1. 6. 5. Illustration in terms of distance learning and use of information technologies

- Educational and interactive games online, or on CDROM.

- Group work, tutoring or mutual educational assistance.

- Simulation.

- Virtual classes and websites allowing the learner to learn through discovery and reception.

1. 7. Neo cognitivism

1. 7. 1. Associated authors

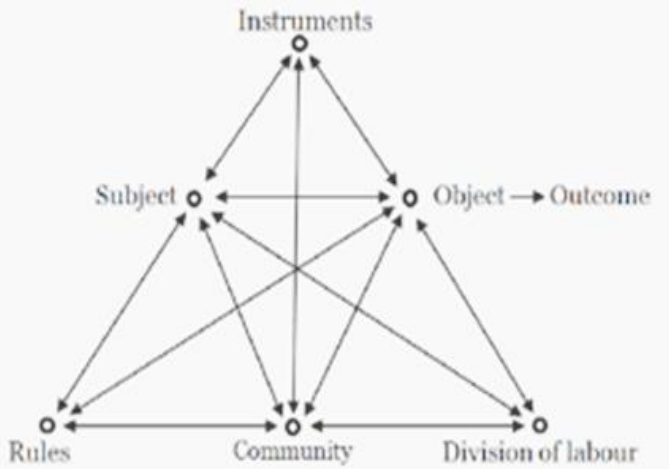
Lev Semionovich VYGOTSKY (1896-1934) was a Russian psychologist and professor at the Institute of Psychology at Moscow University, known for his research in developmental psychology and his cultural-historical theory of the psyche. He devoted himself to the study of the development of higher mental functions. Due to the brevity of his scientific career and the delay with which his work became known outside the Soviet Union (his main work was only translated in 1956 under the title Language and Thought), his influence was mainly posthumous. Vygotsky's work focuses on the mental development of the child, education and psychology. In particular, he developed a conceptual thinking test. But his major contribution lies in the conception he proposes of the role of language in mental development. It gives an essential place to so-called egocentric language, language having a non-communicative function and made up of monologues which accompany the action. The share of this language is very large in children aged five or six, as J. Piaget had already noticed. However, while, according to the latter, such a type of language disappears to make way for socialized language with a communicative function, Vygotsky thinks that it is maintained, but by becoming internalized, and that, in this form, it is an instrument very important in the regulation of activity: it guides the latter and allows access to an intentional type of regulation mode.

David N. PERKINS (1942-) is a founding member of Harvard Project Zero, a basic research project at the Harvard Graduate School of Education that studies human symbolic capacities and their development. He conducts research on creativity in the arts and sciences, informal reasoning, problem solving, comprehension, individual and organizational learning, and the teaching of thinking skills.

Willeim DOISE (1935-2023) is professor of experimental social psychology. He considers that the interactions of social actors are constructed in a balance, within communication relationships. This dynamic is built around problems with strong meaning. It leads to individual positions being taken linked to the social belonging of the actors. Communication relationships have a symbolic character and participate in the construction of identity. He established different levels (four) of reference analysis: intra-psychic or intra-individual level (the study of the mechanisms which allow the individual to organize and control his social experiences), inter-individual or group level (the explanatory variables are located at the level of relationships between individuals or between groups, this is the major approach of interactionism), positional level (the explanatory variables are found in the various positions, or insertions, of subjects in the systems where they evolve) and representational or ideological level (the system of beliefs, representations, values that any society develops, knowing that within these societies the contents will be different depending on the social groups). Ideology is the most complex and least studied level. It is a vast system of explanations of the world and therefore of the subject's place in the world. It can also be defined as an organized set of social representations.

Yrjö ENGESTRÖM (1948-) is professor of adult education and director of the Center for Research on Activity, Development and Learning (CRADLE) at the University of Helsinki (Finland). He considers that the community is defined as a group of individuals who share the same goal. In order to achieve

their common goal, individuals in the same community implement processes of transformation of the existing system (production activity systems). The development of production activity systems does not take place in a linear manner, but via transformation cycles based on the resolution of tensions. In this model, an activity actor is a member of a community of actors working on the same object to create a product together. Individual actions, as well as the necessary exchanges of intermediate products and resources, are carried out through tools, rules and the division of labor inherent in the activity system. The evolution of activity systems occurs from several inputs: the instruments used, the subjects, the objects, the division of labor, the rules applied and the community. Y. Engeström schematized (1987) this evolution as follows.



The cyclical process of an activity draws its strength from the succession of resolutions of internal contradictions appearing within the activity system. The first phase of the cycle is characterized by a gradual worsening of the first-order contradiction existing between use value and exchange value. When other elements change within the activity, the provisionally reached state develops through the

appearance of secondary contradictions between the elements of the system. These contradictions manifest themselves in inextricable situations for individual actors. The adoption of a new mediator, who redefines the object and product of the activity, initiates the process of transformation of the activity system. Caused by collisions between new and old elements of activity, new innovations appear. In the last phase of the cycle of activity expansion through remediations, new mediators must also be created to ensure the interaction between the central activity and the peripheral activities in the network that exists between different activity systems.

1. 7. 2. Definitions of concepts associated with the model

- Sociocognitive conflict

Confrontation with a subject of the same level could be effective, as long as the peer's incorrect responses were different, and allowed the confrontation of points of view in the context of a socio-cognitive conflict situation.

- Zone of proximal development (ZPD)

Vygotsky uses the expression ‘zone of proximal development’ to refer to the gap between solving a problem with the help of adults, or more advanced peers, and that achieved alone.

- Learning community

Brown and Campione give, in an article entitled ‘Designing a community of young students. Theoretical and practical lessons’, a concrete example of organizing a learning community within a class. Mutual assistance established within a community of learners has advantages which:

- arouses emulation,

- gives the opportunity to comment on the work as it progresses,

- allows us to provide support to the most novice,

- authorizes a distribution of work within the group reflecting what is practiced in reality.

- Shoring

Bruner proposes the term ‘scaffolding’ to characterize the pedagogical interactions that take place within a community of learners. These consist, for the more advanced partner, of taking charge of the parts of the task which initially exceed the capabilities of the less advanced partner by allowing him to concentrate on the parts of the task which are accessible to him.

- Cognitive system

The cognitive system consists of a memory and a processor. The memory of the cognitive system includes short-term memory (working memory) which holds the information being manipulated. It allows us, for example, to remember a telephone number while we dial it. The system's memory also includes long-term memory which allows the storage of permanent knowledge. It is the seat of our memories, our knowledge, our skills. The processor of the cognitive system controls the behavior of the individual based on the content of these memories.

- Artifact

For Salomon, the tools provided by the environment do not only play a mediating role, but also an artifact, in the sense that they organize cognitive functioning. The artifacts will be made up of physical tools such as a computer, a video camera, a microphone... but also symbolic ones such as the text composed on the keyboard, the electronic dictionary, the interface which will make it possible to structure the development of texts, etc.

- Cooperation

According to the social constructivist approach, cooperation is interactive group work, where the task is divided between group members, each processing part of the task with a view to later sharing it.

- Collaboration

According to the social constructivist approach, interactive group work where the task is not divided rigidly, but where everyone will participate in a common task. When the task is suitable, studies seem to show that collaborative work leads to more interesting results in terms of learning, but also that the effects of collaborative work can be different depending on certain variables such as the constitution of groups, the characteristics of the task, the modalities of interaction that take place within the group.

- Cognitive trace

It is the result of the intervention of the environment in the cognitive system. Salomon (1995) highlights the very close interaction that exists between the components of the cognitive system mobilized to deal with a situation, that is to say between, on the one hand, the internal cognitive resources of the individual, and on the other hand the environment constituted both by the cognitive tools that it makes available and by the social interactions that develop there. For this author, the environment will not only help the individual find a solution to the problem they have to deal with, but will also leave a cognitive trace on them.

- Culturalism

In one of his works, Bruner (Education, entry into culture, 1996), clearly situates the ambition of what he calls culturalism, affirming that culture shapes the minds of individuals. He insists on the fact that meanings are always culturally situated, that is to say that the meaning given to things is linked to a cultural community of reference. Along the same lines, for Bruner, learning and thinking are activities

always situated within a cultural framework. However, unlike other species, “human beings deliberately teach each other in settings outside those in which the knowledge taught will be used.”

- Individual more

The individual-plus is a concept proposed by the educationalist D. N. Perkins in the mid-1990s. However, its diffusion has remained limited, compared to approaches such as connectivism. However, it is not without heuristic interest and allows us to better understand the reality of learning in the era of digital training. The plus-individual is opposed to the solo-individual. According to D. N. Perkins, the psychology of learning and pedagogy have wrongly focused on the learning processes of the individual alone, forgetting that the learner is caught in a system. The latter includes the learner himself, but also his physical and social environment: his tools available, his resources (procedures, methods, instructions, documentation, etc.), his partners who also have part of the knowledge (network of experts, work colleagues, etc.). In this learning eco-system, knowledge becomes distributed. It is as much in the head of the person themselves as in their tools, their resources or their partners. The concept of individual-plus is therefore inseparable from that of ‘distributed knowledge’. Knowing no longer means being able to repeat, explain or do, it means being able at any time to activate the knowledge distributed in one's environment.

- Distributed intelligence

For Pea, the cognitive system that the subject can mobilize, when faced with a task, includes what he has in his memory, but also all the tools that he can mobilize. Intelligence is therefore not contained only in the individual's brain, but is distributed throughout the physical (cognitive tools) and social (other people) environment.

1. 7. 3. Type of learning

Learning through interactions maintained between the learner and their physical, social but also cultural environment

1. 7. 4. Main ideas to remember from this model

- Learning means communicating with peers to act on cognitive development, and interacting with one's environment in a cultural framework, through adapted artifacts, in order to construct new knowledge.

- Teaching means encouraging communities of learners to help each other by facilitating exchanges. Group work allows each learner to benefit from the knowledge of other learners.

- The role of the teacher is to be a facilitator, a guide, a mediator. He must ensure that the learner does not stray from the goal assigned by the task, and draw his attention to relevant elements.

- The role of the learner is to help each other learn, each according to their abilities (sociocognitive conflict). He must have essential cognitive prerequisites, organize his work and have an overview of its progress.

1. 7. 5. Illustration in terms of distance learning and use of information technologies

- Teamwork. Vary the composition of groups: confrontation with peers at the same level of cognitive development or with more or less advanced peers. These experiments showed that what was important was that the subject had the opportunity to compare their incorrect answers with other points of view, even if these were not necessarily correct.

- Feedback from teachers.

- Distance learning platform, tutoring.

- Films, computer simulations, video camera.

1. 8. The pedagogy of mastery

1. 8. 1. Associated authors

Benjamin BLOOM (1913-1999) is an American psychologist specializing in education. He is known for his important contributions to the classification of educational objectives, and for his Bloom's Taxonomy, useful for evaluating learning progress. Bloom mainly devoted his time to educational objectives and asserted that any task affects one of three psychological domains: cognitive, affective and psychomotor. The cognitive domain relates to knowing and understanding concepts and ideas. The affective domain concerns the attitudes and emotions generated by learning. The psychomotor domain relates to physical manipulation or skills.

Geneva HAERTEL, Ph.D., is a senior researcher for education in the Center for Technology in Learning at ISR. With 25 years of experience researching learning, assessment, and evaluation of K-12 training programs, she has published more than 45 articles on the influences on student learning, and on the conditions that promote student success, including the relationship between technology use and student achievement. Before coming to ISR, she was a senior research associate and co-principal investigator at Temple University's Center for Research in Human Development and Education.

Herbert J. WALBERG (1937-2023) is a scholar at the University of Illinois at Chicago. He was a member of the Koret Task Force on K-12 Education from 1999 to 2013. His research focuses on educational productivity and achievement. Author, or editor, of more than 70 books and approximately 300 articles on topics such as the causes and effects of learning, the effectiveness of teaching and teaching, national comparisons of achievement, as well as measurement and evaluation of education.

1. 8. 2. Definitions of concepts associated with the model

- Prerequisites

Bloom places great emphasis on the importance of prerequisite checks. Indeed, particularly in highly hierarchical subjects, it is essential to be able to rely on perfectly mastered basic skills in order to be able to build others. Control of prerequisites involves checking the mastery and availability of certain skills within the framework of formative assessment procedures and, where appropriate, bringing certain learners up to speed so as to ensure the homogeneity of the group at the time. where learning begins.

- Learning time

Learners are given sufficient time to achieve mastery. Bloom was largely inspired by the work of Carroll in the determining importance he gave to learning time in his model. Carroll defines learning aptitude as the amount of time a student needs to learn a given task, at a given level of mastery, and under optimal teaching conditions.

- High level of mastery, mastery pedagogy

For B. Bloom “Most students are capable of achieving high level learning, if the teaching is adequate and if the students are helped when and where they encounter difficulties, if they are given sufficient time to achieve mastery, and whether there are clear criteria for what mastery is. ".

- Remediation

Students are helped when, and where, they encounter difficulties: mastery pedagogy places great emphasis on the importance of remediation, which goes hand in hand with the ongoing evaluation of students' achievements. In this regard, Bloom speaks of formative evaluation to designate a form of evaluation integrated into the learning process, the aim of which is the immediate diagnosis of difficulties in order to be able to provide a rapid response, in the form of remediation adjusted to needs of each one.

1. 8. 3. Type of learning

- Adequate learning which allows, based on the method of meta-analyses, to highlight the effects due to certain variables, by grouping together studies concerning them to identify a certain number of trends. This method thus allows an average, or even weak, learner who benefits from adequate educational treatment to obtain results comparable to those of a strong learner who would not have benefited from such learning.

- High-level learning which allows you to achieve an appreciable level of mastery, and a significant rate of return.

- Formative evaluation which aims to inform the learner as completely and precisely as possible about the distance that separates them from the objective to be achieved and about the difficulties they encounter. This is an evaluation of learning, without a definitive opinion being given regarding the candidate's level.

1. 8. 4. Main ideas to remember from this model

- Learning is:

  - master and achieve learning objectives,

  - provide the time necessary for learning,

  - achieve a high level of mastery.

- Teaching is:

  - help learners, in relation to the prerequisite, to reach the level of mastery of a module, then measure this level and try to maximize it through feedback (formative evaluation),

  - the design of tasks to lead the learner, slowly but surely, towards the achievement of the objectives corresponding to their program of study,

  - permanently regulate learning through remediation,

  - promote the development of the potential of each learner.

The role of the teacher is:

  - to increase the level of mastery through feedback and remediation,

  - to take into account the differences between individuals and in particular their learning time in order to stimulate learning rather than planning the same duration for everyone and thus anticipating the failure of certain learning times for students,

  - help learners when and where they encounter difficulties.

The role of the learner is:

- have a prerequisite,
- match the time spent learning a specific subject to the learning time defined by the teacher,
- tencourage his peers,
- be able to appropriate what is taught,
- achieve a high degree of mastery according to the objectives sought.

1. 8. 5. Illustration in terms of distance learning and use of information technologies

- Cognitive remediation software is used with children and adults with cognitive disorders, mainly affecting the functions of attention and memory, perception and language. They also enable problem-solving work. They come in three modules according to Jean Chatelois, neuropsychologist.

- Tutorial (software),
- Individualized tutoring,
- Scheduled teaching.

2. Software

Several terms are linked to the word software[2], open source, proprietary, freeware, shareware, shareware, copyright, copyleft, etc. It is difficult to understand the exact meaning of these terms, especially since most of them have only appeared in the IT field recently.

To the extent that these terms have imposed themselves on us, we might as well understand them and for that we will define this name. However, to properly situate this terminology in relation to its environment, after a brief history, we present certain software, or associated terms, quite succinctly, in order to better understand their differences and similarities.

2. 1. History

Historically with computers in the 1960s, software, along with its source codes[3], was distributed with the hardware and was not considered a salable commodity. This resulted from the strong dependency that existed between the software, usually written in machine language, and the hardware. Software purchasers therefore obtained the software sources (including operating systems) and the right to modify them. Operators of the first mass-produced computers got into the habit of forming user groups to share their experiences. These groups were supported by the manufacturers themselves and software

[2] Software is a “set of programs, processes and rules, and possibly documentation, relating to the operation of a set of data processing operations” (source: Le petit Larousse 2010). Software is divided into two broad categories: system software and application software. The first constitutes part of the operating system and participates in controlling the functioning of the computer. It manages essential tasks such as maintaining files on the hard drive, managing the screen, keyboard, etc. Application software, simply called “software” in common parlance, is the most used. It is made up of a set of computer programs that assist the user in a specific activity. A computer without software cannot function, it's a bit like a car without energy.

[3]Source code is a set of instructions written in a high-level computer programming language, understandable by a trained human, to obtain a program for a computer.

modifications were exchanged. At that time, it was hardware that was supposed to be the source of revenue, with software just a means to facilitate its sale. Access to source code was normal, because no one bought a computer without having a team of programmers. Professional and academic circles willingly exchanged software and source codes, and manufacturers gave theirs away for free. However, with the development of computing (particularly microcomputers), manufacturers realized that they could obtain greater profit by marketing software and hardware separately.

In the early 1970s, providing free software was considered an anti-competitive practice and therefore prohibited to manufacturers, forcing them to charge separately for their software and hardware. In fifteen years, the advent of microcomputers will give a boost to software publishers who are moving towards the sale of user licenses. At the same time, manufacturers have restricted access to the source code of programs, because the modifications often made by customer teams make remote technical support problematic. It becomes impossible, and in some cases prohibited, to study, correct or improve acquired software. Not only can the user no longer adapt the software to his wishes, but in the event of a bug[4], he finds himself dependent on the goodwill of the software publisher. Finally, copying, a natural operation for a computer, generally becomes prohibited (by default, copyright prohibits copying not explicitly authorized). Software available only under these restrictive conditions then becomes the rule, and software previously freely exchanged often finds itself integrated into fixed and non-shareable commercial products.

With the creation of this new market, new terminology linked to software appears: free software, open source, proprietary, freeware (or freeware), shareware (or shareware). The differences between these software programs mainly lie in their distribution, use and copying.

[4] A computer bug (from the English bug, “insect”) is a design defect in a computer program causing a malfunction.

2. 2. Free software

At the origin of this software, there is a resistance action which contests the emergence of a commercial offer of software, subject to intellectual property law via user licenses. Richard Stallman[5] deeply feels this change when the colleagues with whom he worked and exchanged software until now are in turn hired to produce software that they will no longer be able to share. Driven by a scientific spirit, and by values of collaboration and exchange, it invites computer scientists to embark on the design of an alternative offer of "free software", freely designed by and for users. In 1983 he created the GNU project[6], which aimed to build an operating system compatible with Unix[7] and all of whose software was freely shareable. Alongside the development work undertaken, Richard Stallman founded the Free

[5] Richard Matthew STALLMAN (born in Manhattan, March 16, 1953), also known by the initials RMS, is a programmer and free software activist. He is at the origin of the project known by the acronym GPL. He popularized the English term copyleft. A renowned programmer in the American and international computer community, he has developed numerous software programs. Since the mid-1990s, he has devoted most of his time to promoting free software to various audiences around the world. He earns part of his living with the speaker fees that are given to him on occasion or the prizes that are given to him.

[6] The GNU Project is a hacker community ("There is a community, a shared culture, of experienced programmers and network specialists, whose history dates back to the first multi-user minicomputers, a few decades ago, and the first experiments with the ARPAnet [the network known today as the Internet]. Members of this culture created the word "hacker". They are hackers who created the Internet. hackers who made the Unix operating system what it is today These are hackers who run Usenet newsgroups and the Word Wide Web » Eric Raymond) initiated in 1983 by Richard Stallman to create the system. GNU exploitation. It is supported by the Free Software Foundation (The Free Software Foundation, literally "Foundation for Free Software", is an American non-profit organization founded by Richard Stallman on October 4, 1985, whose global mission is the promotion of free software and user defense.) and is organized into sub-projects, all driven by the values of free software and its social dimension. It represents the founding act of the free software movement.

[7] UNIX (officially registered as UNIX, sometimes also written as UNIX with small capitals) is the name of a multitasking, multi-user operating system created in 1969, conceptually open and based on an approach by which it offers many small tools each with a specific mission.

Software Foundation in 1985, literally "Foundation for Free Software", which is an American non-profit organization, whose global mission is the promotion of free software and the defense of users. This is how the principle of “free software” is born. The goal of free software is to allow the complete sharing of information, hence the reference to freedom. The developers and users of free software are independent, without any particular political leaning, and their motivations are diverse. They create or use tools based on a mode of production based on collaboration, mutual aid, sharing and pooling.

The expression "Free Software" refers to freedom and not to price, by which we mean that it respects the essential freedoms of the user: the freedom to execute, to copy, to distribute, to study, modify and improve the Software without asking or paying for permission. More specifically, this means that users have the following four essential freedoms:

- Freedom to run the program, for all uses.

- The freedom to study how the program works, and to adapt it to your own needs. For this, access to the source code is a required condition.

- The freedom to redistribute copies, therefore to help your neighbor.

- The freedom to improve the program and publish the improvements, to benefit the entire community. For this, access to the source code is a required condition.

These freedoms are vitally important. They are essential, not just for the individual issues of users, but because they promote social solidarity, which is sharing and cooperation. They become even more important as more of our culture and daily activities become digitalized. In a world of digital sounds, images and words, free software becomes increasingly necessary for freedom in general.

The rights corresponding to these freedoms may be simply available (as for public domain software) or established by a software license[8] so-called "free"[9] license based on copyright; the licenses which guarantee the maintenance of these rights to derived software are called "copyleft licenses"[10].

"Free software" does not mean "non-commercial". Free software must be available for commercial use, for commercial development and commercial distribution. Commercial development of free software is no longer the exception; such commercial free software is very important. You may have paid to obtain a copy of free software or you may have obtained it for free. But regardless of how you obtained it, you always have the freedom to copy and modify software and even sell copies of it. Free software is often distributed free of charge, for example on FTP servers. But copies of free software are also available on

[8] A software license is a contract by which the owner of the copyright on a computer program defines with his co-contractor (operator or user), the conditions under which this program can be used, distributed or modified.

[9] A free license is a license applying to an intellectual work by which the author grants all or part of the rights conferred on him by copyright, leaving at least the possibility of modification, redistribution and reuse of the work in derivative works. These freedoms may be subject to conditions, in particular the systematic application of the same license to copies of the work and to derived works, a principle called copyleft.

[10] Copyleft is the possibility given by the author of a work subject to copyright to copy, use, study, modify and/or distribute his work to the extent that these possibilities remain preserved. The author therefore does not authorize his work to evolve with a restriction of this copying right, which means that the contributor making a modification (a correction, the addition of a functionality, etc.) is forced to only redistribute your own contributions under the same conditions of use. In other words, creations made from copyleft elements inherit this characteristic. "The central idea of copyleft is to give anyone permission to run the program, copy it, modify it, and distribute modified versions of it - but not permission to add restrictions of their own. This is how the crucial freedoms that define free software are guaranteed for anyone who owns a copy; they become inalienable rights. » (Richard Stallman)

paid CD-ROMs and copies of proprietary software may occasionally be available for free in promotions and some proprietary software is normally available free of charge to some users.

With the emergence of the Internet, and the possibility for users from around the world to contribute to a common project within virtual communities, the first free software appeared.

At the end of the 1990s, the success of proprietary software embodied by Microsoft alone was threatened by the emergence of a competing offering developed under a “copyleft” license. The advantage of this software is that it is distributed free of charge, which ensures its success. While the symbols of excessive capitalism are torn down, free software soon comes to embody an ideological crusade.

However, not all free software users and developers agreed with the goals of the free software movement. In 1998, part of the free software community broke away and began campaigning in the name of “open source”.

2. 3. Open source software

Confusion between free software and open source is common in the media which often use the two terms without distinguishing them. The use of the designation Open Source was initially suggested in order to remove the ambiguity of the English word Free Software which means free in the sense of "freedom" but above all "free", and thus remind users that software has a cost . It was also a question of choosing a vocabulary that better corresponded to the business world, the term Free (Free Software) generally running the risk of worrying businesses. The main argument for using the term "open source" is that "free software" makes some people suspicious. Indeed, talking about freedom, ethical questions, responsibilities as well as convenience is asking people to think about things they would prefer to ignore and this can lead to a certain discomfort. Free software developers have noticed this reaction, and some have begun to explore ways to avoid it. They assumed that by ignoring ethics and freedom, by only talking about the practical and immediate benefits of certain free software, they could “sell” free

software more effectively to certain users, mainly in businesses. This is why they used the term “open source”, to be “more acceptable in business”. Some of the proponents of "open source" saw this as "a marketing campaign for free software" that would appeal to business executives by citing practical benefits, while avoiding ideas of right or wrong that they might not love to hear. Other supporters categorically rejected the moral and social values of the free software movement. Whatever their point of view, during their campaign on "open source" they did not mention or advocate these values. This new approach has convinced many companies and individuals to use open source.

The term "open source" quickly became associated with the practice of citing only practical values, such as making powerful and reliable software. Virtually all “open source” software is free software; both terms describe virtually the same category of software. But they represent views based on fundamentally different values. “Open source” is a methodology that emphasizes the development and distribution of software; free software is a social movement. For the free software movement, free software is an ethical imperative, because only free software respects the freedom of the user. In contrast, the “open source” philosophy only considers practical issues in terms of performance.

Thus, Free Software under a copyleft license is open source, while Open Source software may not be free. In practice, most Open Source licenses meet the freedom criteria of the Free Software Foundation, the different subtleties that distinguish them being mainly philosophical and commercial.

The main criticism from the parent movement of Free Software is the fact that Open Source communicates almost exclusively on one of the technical characteristics of software (freedom of access to the functioning of the software) while obscuring the primary motivations from which they come. , at the risk of losing them. They accuse Open Source of being driven by the dynamics and financial resources and expertise of multinationals, opposing it to Free Software driven by philosophical and political ideals.

2. 4. Proprietary software (also called proprietary software or non-free software)

The term "proprietary" refers to the fact that the author retains control over the ownership and usage rights of the software. Proprietary software refers to software that has been published without providing the technical or legal means to use and study it freely. This is materialized by restrictions on use, distribution, modification and development.

The terms of use of software are copyright because the software is a creation of the mind, even though many copyright laws treat software as a special case.

Accordingly, a user may only use software in compliance with the software's copyright. In most cases, the software author remains the owner of the software. When the authors are employees, the rights are directly vested in the company by law (the employer does not need to have them transferred).

All terms relating to notions of sale or purchase of so-called “proprietary” software mean “transfer of rights to use the software” and do not mean “transfer of ownership of the software”. Consequently, software qualified as "proprietary" by misnomer, and made available to a user, remains the property of its author, a natural person or legal entity (company); and the author retains the rights granted by copyright, in particular the copying monopoly.

The author entrusts his software to the user so that the latter makes a defined use of it, in particular by the user to give up studying the functioning of the software. To access the right to use proprietary software, the user must generally accept a contract in which they refrain from copying all or part of the software and also from transcribing it into another language.

As an exception to this general regime, certain national laws authorize reverse engineering and the creation of a backup copy.

2. 5. Free software (freeware or freeware)

Free software is software made available free of charge by its creator. Free software distribution is of obvious interest to major players in the software world. In one case, this may involve distributing software with reduced functionality free of charge, in the form of a loss leader, to encourage some users to use the paid version or other products from the same publisher. Free distribution can also be carried out with the aim of creating an addiction to the publisher's products or with the aim of becoming a de facto standard.

In the case of development carried out by enlightened amateurs, free distribution of the software is a necessity, at least initially, to ensure the propagation of the software. These freeware authors cannot afford, if they want their software to be used, to charge for it.

Freeware should not be confused with shareware, where you can use the complete or restricted software for free but for a specific period: for example, word processing software could prohibit the saving of files created, or operate only for the 2 months following installation.

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