Learning models

Preface

Le **Carrefour de la réussite au collégial** was created by the Fédération des cégeps to support cégeps in the implementation of programs geared toward student success. The means of achieving this include the organization of conferences, symposiums, thematic workshops, regional meetings and support for the development of learning tools with tracking and diagnostic purposes.

The Carrefour has identified a certain number of axes of improvement and entrusted **PERFORMA** with the preparation of learning kits showcasing activities on each of these axes. This kit consists of a single document that includes both the animation guide and the complementary texts.

Attentive readers will have noticed that learning kits # 6 *New educational strategies and* # 7, *Learning models* are connected. Indeed as concerns their content, both are inspired by the same teaching movement, cognitivism; their approach stems from a similar desire, that of 'practicing what they preach' and ensuring congruence from one to the other.

Although complementary, both kits remain different. The first encourages us to try out several approaches that place the learner at the heart of the learning process, the first principle of cognitive pedagogy. The second principle centers on the learning process with each learning activity sensitizing us to the concept as well as the practical side at each stage of the process. The kit also integrates the concept of competency and the construction of learning activities. There is no doubt that one and the other will prove helpful to college personnel who are concerned about pedagogical methods and success.

Special thanks

Contribution of authors:

We wish to thank the following authors who contributed to the inspiration and enrichment of this kit on "learning models" and their editors who gave us permission to reproduce the texts.

BRETON, J. (1991). La schématisation des concepts : un instrument de développement des habiletés conceptuelles au collégial. Pédagogie collégiale.

LAFORTUNE, Louise. D. C. (2001). Accompagnement socioconstructiviste. Pour s'approprier une réforme en éducation. Sainte-Foy, Presses de l'Université du Québec.

LASNIER, François. (2000). Réussir la formation par compétences. Montréal, Guérin.

LEGENDRE, A.-M. (2001). Favoriser l'émergence de changements en matière d'évaluation des apprentissages. Vie Pédagogique, 120 (September-October), 15-19.

OUELLET, Yolande. (1997). Un cadre de référence en enseignement stratégique. Vie Pédagogique, 104 (September-October), 4-10.

PÔLE DE L'EST et al. (1996). Processus de planification d'un cours centré sur le développement d'une compétence. Rimouski, Délégation collégiale Performa.

RAYMOND, Danielle. (2001). Qu'est-ce qu'apprendre? ou Apprendre, oui mais. Sherbrooke: MIPEC, Performa, Université de Sherbrooke.

SIROIS, Gervais. (2002). Tableau des intelligences multiples. Centre D'étude Et Développement Pédagogique.

Consultants :

A special thank you for their invaluable advice to:

MICHAUD, Jean-Paul, consultant, Carrefour de la réussite au collégial.

LAMONTAGE, Armand, consultant, PERFORMA representative for the production of this learning kit.

Table of contents

Section II
Sensitization activities

General presentation of the activities

The kit on “Learning models” includes three essential parts:

- Section II includes eleven sensitization activities
- Section III introduces the learning tools in support of the sensitization activities
- Section IV contains various documents that support and prolong the sensitization activities.

The presentation of the activities respects an established order that goes from an initial level of sensitization, to acquisition, application, and finally to integration. To structure the sequence of the sensitization activities, we referred to a typical learning process which will be discussed in activity 10. This process can help us identify how we learn and consequently how we can structure interventions in an organized way. These sensitization activities were developed in accordance with accepted cognitive principles in order that participants may explicitly experience the typical learning process that they have their students go through.

This process has six stages:

A typical learning process	
Activation	Awakening of the student’s cognitive and emotional acquisitions in relation to the competency or knowledge to be acquired.
Elaboration	Establishment by the student of links, correct or erroneous, between what he knows and what he is learning and what he seeks to understand.
Organization	Clear and correct structuring of knowledge by the student.
Application	Use of conceptual or declarative, procedural and conditional knowledge acquired in the organization stage with decreasing assistance and support.
Proceduralization	Use of structured acquisitions in increasingly complex situations so as to develop the ability to act quickly and effectively. This stage aims at making the implementation of problem solving stages increasingly automatic.
Integration	Implementation of acquisitions connected to the development of the competency in an increasingly autonomous fashion. The ultimate goal of learning is the integration of new acquisitions to the student’s existing organization of knowledge and his way of approaching situations based on this new organization.

(Pôle de L’Est, 1996: 119-121)

A student who is learning sets in motion a series of cognitive operations, as illustrated by the "typical learning process".

“When a student learns, he must remember what he knows about the subject (**activation of acquisitions**) and formulate explanatory assumptions about the phenomena he is trying to

understand, based on these acquisitions (**elaboration**). These first two stages are not enough and the student must also be put in contact with the new learning so he can make it “his” and with assistance, organize the information in the form of a cognitive network; establishing the relevant links between elements (**organization**). If these relationships are not well established by the student, the information will be learned superficially (surface learning). After organizing it, the student must apply this organized knowledge to simple situations (**application**) before being able to apply it in an increasingly "automatic" way (**proceduralization**) to increasingly complex contextualized situations, by connecting it to increasingly rich (deep) knowledge (**integration**)".

Here the professor’s role consists of determining the learning situations and the sequence of teaching and learning activities most likely to support each stage in the development of a competency, then to organize them according to the learning process in question.

We have tried to establish the presentation order of the sensitization activities in accordance with a typical learning process. Reference to this process will be indicated in the presentation of an activity. Each activity is described on one or two pages and contains the following:

- title
- objective (s)
- reference to the learning process
- short description
- unfolding
- role of the moderator
- role of participants
- necessary material
- teaching equipment
- support documentation
- comments (if necessary)
- approximate duration

The role of the participants is mainly centered on the personal expression of their notions and representations, on their interactions with other participants and finally on metacognitive operations supporting the recognition of their own ways of learning.

The role of the moderator is to encourage the participants to express themselves freely, to facilitate exchanges and discussions between them, to clarify interpretations recognized in the group and to favour reflection. Although the material presented in the sensitization activities is complete in itself, it requires meticulous preparation on behalf of the moderator both in terms of contents and process planning.

Moreover, even though it is preferable to organize further training following the activities outlined herein, many will benefit from one or more of these sensitization activities within the framework of a personal development program. Lastly, some readers may find it surprising that teamwork is often called into play, despite the assumption that learning is individual and the result of a personal construct. This is not a contradiction, but rather the application of one of the socioconstructivist principles according to which the "learner learns with the help of others" (see document 6).

Short description of the activities:

Activity 1 is an introduction to the subject matter that allows for the emergence of the participants' prior knowledge on learning models. It is the first stage of the typical learning process.

Activity 2 relates to the schematization of concepts. It orchestrates participants in the organization of knowledge. It does not relate specifically to learning models, but due to the importance of this learning technique, we thought it preferable to include it in the initial sensitization activities. This technique will be necessary to carry out activity 3.

Activities 3 and 4 make it possible to draft an overview of learning models. The activities must be carried out in order: activity 3 describes the models while activity 4 deepens knowledge on the principles that distinguish the models.

Activities 5 and 6 make it possible to shed light on the significant changes brought about by the learning paradigm. Research on the various learning models has led the educational decision-makers to create pedagogical applications based on the learning paradigm as opposed to the teaching paradigm. This change puts the student at the heart of its own learning. Activity 6 covers this aspect and is designed to have the participants reflect on their own concept of learning.

Activities 7 and 8 are centered primarily on teaching practices. The choice of teaching methods reveals the professor's vision of teaching. Activity 7 makes it possible to compare our pedagogical concepts with those of others. And since the knowledge to be taught at collegial level deals with competencies, activity 8 offers an opportunity to evaluate the impact on our teaching of principles based on the nature of a competency.

The three last activities (9, 10, and 11) are more complex. Their goal is the application and integration of learning strategies and techniques supporting the construction of knowledge in the learner. They make it possible to describe learning via a problem situation, to apply a typical learning process in a lesson plan and to determine promising leads for the creation of learning activities.

Activity 1

Title	**My beliefs on learning models**
Objective	To elicit the emergence of prior knowledge on learning models.
Learning process	Stage 1: *Activation,* awakening of cognitive and emotional acquisitions

	relative to the development of knowledge.
Description	To produce a teaching poster depicting the personal knowledge of the participants. Prior knowledge is knowledge which the students already have on a subject, before the start of the new activity or project. This knowledge can be right, partially correct and erroneous. Spontaneous ideas can also reflect prior knowledge. The activation of prior knowledge is an important stage. The professor brings about the emergence of the students' prior knowledge through activities that support the acquisition of new knowledge.
Unfolding	1. Individually, each participant writes down what he knows about learning models and various teaching approaches. 2. In teams of four, participants then use these individual notes to create a poster depicting the participants' beliefs and knowledge on a specific subject. Limit of one poster per team. 3. The posters are posted on the walls of the meeting room. 4. The participants of all teams circulate to see the content of other posters. 5. Pooling and elaboration on a collective poster to depict the spontaneous ideas of participants.
Role of moderator	▪ To foster a climate favourable to reflection. ▪ To encourage questioning. ▪ To be receptive to a wide range of answers. ▪ To display and re-use the knowledge collected when all information is pooled.
Role of participant s	▪ To express their concepts openly. ▪ To support interaction among participants. ▪ To look within and identify their own concepts relative to learning models. ▪ To establish links.
Necessary material	▪ Large sheets of approximately 60 cm x 85 cm. ▪ Colour pencils, post-its and adhesive paper
Pedagogical material	Tool 1.A: Prior knowledge Tool 1.B: Teaching is not learning
Supporting document	Document 1: The learner's concepts are the starting point for learning. "Work with to go against".
Comment	The activity ends with the production of a collective poster. A consensus on all elements in the poster is not necessary. What counts is the identification and expression of participants' personal concepts.
Approximate duration	Minimum 2 hours

Activity 2

Title	**The concept of a diagram**
Objective	To learn how to make a diagram and schema of a concept.
Learning process	Stage 3: *Organization,* clear and correct structuring of knowledge.
Description	To produce a diagram or a graphic representation. Graphic representations are visual models of verbal statements. They help the learner understand, summarize and synthesize complex ideas. A fundamental rule underlying the construction of graphic models is that the structure of the model should reflect the structure of the text it represents. A good graphic model can show at a glance the key parts of the unit and their relationships and thus enable a global comprehension that words alone cannot convey. This activity makes it possible to acquire the procedures necessary to create a graphic representation.
Unfolding	1. In the following paragraph, select what you consider to be two general abstract concepts and two very specific concepts. Underline them. *"All that is alive needs energy. Plants and animals use energy for their vital activities. Certain vital activities common to plants and animals are growth, reproduction, breathing and the transport of materials. Only green plants produce food. Animals cannot produce their own food; thus they need to displace themselves to find their food."* 2. On a sheet of paper, each individual writes these four concepts in separate rectangles, placing the more general and abstract concepts at the top of the page and the specific statements at the bottom. Separate the concepts so that you can trace lines of relationships between them and write them on the paper. You might want to assign the same rank to certain concepts by placing them on the same horizontal level. 3. Draw the lines to show relationships between the concepts and write what connects the concepts to each other. This stage is crucial and can involve a rearrangement of the concepts. The relationships are usually expressed by verbs and are read from top to bottom, to show their hierarchical structure. Try to establish the most links possible, but do not cross the lines of relationships already in place. 4. Compare your diagram with that of a partner and discuss the differences. Make sure that the most abstract, general and important concepts are placed at the top, and that the more concrete and vivid concepts are placed at the bottom of the sheet. 5. Now, go back to the first stage, underline four other concepts, and repeat steps 2 and 3. 6. Presentation of some diagrams in front of the group of

	participants, then discussion on the schema presented by the moderator. 7. Discussion in groups on the usefulness, the relevance and the procedures involved in producing diagrams of concepts.
Role of moderator	▪ To model the strategy of concept organization ▪ To provide examples of concept organization ▪ To help participants develop graphic representations with particular attention to the creative process.
Role of participants	▪ To engage actively in the process of concept organization. ▪ To become aware of the usefulness of the organization strategy. ▪ To engage actively in the completion of the activity. ▪ To account for the use of their own personal strategy.
Pedagogical material	Tool 2: Schema of a concept
Supporting document	Document 23: The schematization of concepts: a tool for developing conceptual skills at collegial level.
Approximate duration	Minimum 2 hours

Activity 3

Title	**Various learning models**
Objectives	1. To experiment using an organizational model for knowledge. 2. To establish links with personal prior knowledge. 3. To sketch a global portrait of the subject to be mastered.
Learning process	Stage 3: *Organization,* correct structuring of knowledge.
Description	To produce a diagram of concepts on the various models. Organizing knowledge in memory makes it possible to get a better mental representation of old and new knowledge which, consequently, increases recall ability. The selection of information requires that the participant distinguish relevant information from superfluous and irrelevant information. Thus, he can add his new knowledge to his starting organizational structure, establish links with his prior knowledge, and reach a global overview of the learning models to be mastered.
Unfolding	1. Discussion of the spontaneous concepts of the participants. 2. In teams of 3 or 4, produce a schema of concepts on the four learning models: behaviourism, cognitivism, constructivism and socioconstructivism. 3. Display the schema on an index card. 4. When the information is pooled, each team presents its own index card. 5. Discussion: what each individual retains in relation to the spontaneous concepts.
Role of moderator	▪ To provide diversified tools for organizing knowledge. ▪ To plan specific moments for organizing knowledge throughout the project. ▪ To model strategies regarding knowledge organization.
Role of participants	▪ To engage actively in the process of knowledge organization. ▪ To become aware of the usefulness of the various organizational strategies. ▪ To choose an organizational strategy relevant to the context in which it is used.

Pedagogical material	Tool 2: The schema of concepts Tool 3. A: The behavioural concept Tool 3. B: Cognitivism Tool 3. C: Historico-cultural or sociohistoric approach (Vygotsky) Tool 3. D: Constructivism Tool 3. E: Socioconstructivism Tool 3. F: Distinctions between three approaches: cognitivism, constructivism and socioconstructivism
Comment	The level of difficulty of this activity is relatively high for participants who are not already aware of the various learning models. The important thing is to characterize each model and to recognize what applies to it particularly. Precise information is not the goal here.
Approximate duration	The duration varies according to the degree of complexity. However, three hours are usually set aside for this activity. It is better to request that the texts be read prior to their study in teams.

Activity 4

Title	**Principles relative to learning models**[1]
Objectives	▪ To classify the principles as belonging to behaviourism or constructivism. ▪ To identify the principles relative to these models that support professional practices.
Learning process	Stage 3: O*rganization*, the structuring of knowledge by the learner.
Description	As we acquire experience, we develop our own intervention models with different groups. A difficulty experienced in some situations and with specific groups or within an innovative teaching approach can lead to a reflection on the foundations of our teaching practices, i.e. their essence. The goal of this activity is to become aware of the principles guiding our practice while making it possible to distinguish the principles put forth by behaviourism from those inherent to constructivism, and also socioconstructivism.
Unfolding	1. Orally reply to the questions and write down the answers: 1.1 What is behaviourism? 1.2 What is constructivism? 1.3 What is socioconstructivism? The answers are used to review the activity. 2 Participants are asked to rate a series of statements (tool 3.A), indicating the concepts of teaching and learning that best describe participating professors (1: statement which does not describe their concept at all and 5: statement which describes their concept perfectly). 3 Produce a synthesis of the answers given by the group. The moderator can use this opportunity to clarify the statements used in the activity and highlight different and opposing interpretations. 4 To determine which statements best describe behaviourism and constructivism respectively. Here again, care should be taken to ensure that erroneous interpretations are discussed so that the members of the group can reach agreement on them, i.e. by confronting them to widely recognized interpretations in literature so as to make the appropriate adjustments. (Use Tool 3.B) How have your definitions of behaviourism and constructivism evolved? (See stage 1 above)
Role of moderator	▪ To foster a climate where participants feel at ease to express themselves. ▪ To facilitate exchanges and discussion. ▪ To outline the most recognized interpretations on the

[1] Adaptation of Lafortune, 2001: 71-77

	principles and professional practices of the learning models presented.
Role of participant s	▪ To freely express their concepts. ▪ To actively participate in group discussions so as to confront and validate their own concepts.
Teaching material	Tool 4.A: Guiding principles for teaching practices Tool 4.B: Synthesis of principles and professional actions within the behaviourist and constructivist movements
Supporting documentation	Tool 3. B: Cognitivism Tool 3. C: Historico-cultural or sociohistoric approach (Vygotsky) Tool 3. D: Constructivism Tool 3. E: Socioconstructivism Tool 3. F: Distinctions between three approaches: cognitivism, constructivism and socioconstructivism Document 14: Abstract of current theories on new approaches
Comment	This activity raises questions on the "true definition" and consequently on "truth" and "reality". Implicitly, the selected training approach brings about the experience of a constructivist principle, whereby each person builds his own reality. For this reason, it is necessary to clarify the concept of "viability" of a given construct. This viability can be tested by confronting a given structure with those of other members of the group or various authors. The supporting documentation serves as an extension of the personal reflection on the theme. Reading this documentation is a complementary activity that is not essential to carry out the activity.
Approximate duration	Three hours

Activity 5

Title	**Change of paradigm**
Objective	To recognize the significant changes present in the learning paradigm.
Learning process	Stage 2: *Elaboration,* each participant establishes links, accurate and otherwise, between what he knows and what he learns or a phenomenon he wishes to understand.
Description	Activity: to complete a comparative table. The participant establishes links between what he knows and what he learns or a phenomenon he seeks to understand .This activity provides explanations for the phenomenon and makes it possible to confront the information provided by the participants on the change of paradigm. The cognitive capacity called into play is "to “compare”, which makes it possible to recognize the characteristics of the teaching paradigm and the learning paradigm according to various indicators.
Unfolding	1. In teams of 3 or 4, participants initially discuss the concept of paradigm and specify how it can facilitate a reflection on a given frame of reference for teaching. This introduction to the subject matter could also work well in a collective setting i.e. in a large group. 2. Each team is given a table (Tool 5.B) containing various information categories relative to the characteristics of the two paradigms written on cardboard cut-outs (Tool 5.C). 3. The task consists of completing the table using the correct cardboards at the appropriate places. 4. We must reach consensus on the classification of the characteristics. 5. When the teams have completed the task, the moderator gives them the answer sheet containing the correct answers (Tool 5.D). 6. Pooling of information in a group to answer the following questions: what defines my professional practice? And is this concentration on learning really something new for participants?
Role of moderator	• To foster a climate favourable to reflection. • To explain the instructions clearly. • To encourage questioning. •To support exchanges rather than a search for the correct answer.
Role of participants	• To identify all the knowledge they possess. • To reflect rather than confront. • To establish links.
Necessary material	Cardboard cut-outs and answer sheet
Teaching material	Tool 5.A: The paradigms of teaching and learning (useful for the

	moderator) Tool 5.B: Form 1: table to be completed Characteristics of the learning paradigm versus the teaching paradigm Tool 5.C: Form 2: cardboard cut-outs Tool 5.D: Form 3: answer sheet
Supporting documentation	Document 11: From a teaching paradigm… to a learning paradigm Document 12: Consensus on the new learning paradigm
Approximate duration	Minimum: two hours

Activity 6

Title	**The student at the heart of his own learning**
Objectives	1. To reflect on our own concept of learning. 2. To recognize the underlying teaching principles relative to our professional practice. 3. To evaluate the impact of our own concept of learning on our teaching practices.
Learning process	*Stage 2: Elaboration,* the participant formulates explanatory assumptions on his professional practice based on his acquisitions and the experiences of other participants.
Description	Activity for reflection and construction of knowledge via interactions within the group.
Unfolding	1. Each participant completes a personal index card that provides answers to these questions: - What is learning? - What are the general pedagogical principles that guide my professional practice? 2. In teams of 4 or 5 people, participants work towards a consensus on the definition of learning. Then they compare it to the definition presented by the moderator (tool 6.A). 3. Each participant writes down the pedagogical principles which guide his professional practice. Then, using these individual answers, a list of general pedagogical principles is created using those that received approval from the majority of the participants. To this list, we add the principles presented by the moderator (tool 6.B) dealing with the teaching principles that guide participants. 4. Group discussion on the consequences of these principles on teaching. Use of the statements presented by the moderator according to two perspectives: cognitive and constructivist. (Tool 6.C). 5. Collective evaluation of the value of the exchanges in this activity.
Role of moderator	▪ To facilitate personal reflection. ▪ To create conditions which facilitate participation. ▪ To present new pedagogical material mainly by answering questions from the participants. ▪ To assist participants in clarifying their own idea of learning and its consequences on teaching.
Role of participants	▪ To engage actively in a personal reflection.

	▪ To facilitate the interactions in the group. ▪ To seek to formulate a personal synthesis. ▪ To evaluate the learning strategies they used in the activity.
Pedagogical material	Tool 6.A: A learning concept Tool 6.B: Teaching principles that guide my practice Tool 6.C: The learner at the heart of teaching
Supporting documentation	Document 3: Learning principles Document 4: Planning the development of a competency based on a typical learning process Document 5: Application of educational principles in the implementation of study programs Document 6:Students at the center of their own learning
Approximate duration	Minimum: two hours This does not include reading the supporting documentation as an extension of the activity.

Activity 7

Title	**Teaching visions**[2]
Objectives	1. To identify our own pedagogical practices. 2. To compare our pedagogical practices with those of others. 3. To study various teaching practices relative to the spirit of reform. 4. To compare our own pedagogical concepts with those of others.
Learning process	Stage: *Elaboration*, understanding based on our own past experiences. And also *Organization*: to establish links between our own pedagogical practices and our own visions of teaching.
Description	From a training perspective, it seems essential to question our own pedagogical practices and ideas. We often have the impression we know who we are, but our self-knowledge is not always true to reality. Our own approach is not always diversified enough to reach all types of learners. By reflecting on various pedagogical methods and by discussing them with colleagues, we recognize that some practices are beneficial and worthwhile incorporating into our own practices.
Unfolding	1. Initial individual reflection: to better understand their own pedagogical practices, participants complete tool 7.A that lists teaching methods. They initially measure the frequency of use of each method relative to their practice and those of the teaching personnel at their college. 2. To understand one's own pedagogical practices, Tool 7.B is completed individually. This tool contains a list of statements describing the actions of a person in a teaching situation. 3. Using Tool 7.B from previous step, solicit the feedback of those whose response is different from yours. Place their initials in the signature box. The objective is to collect the greatest number of signatures and the greatest number of different signatures. This one way of fostering a climate of security within members of the group. 4. Initiate a reflection on the different responses provided. For which statements did we find it difficult to get signatures? Which were easy? 5. Working in teams, participants identify those pedagogical practices that strongly support the socioconstructivist approach. The use of Tool 7.C initiates a reflection on pedagogical methods and their links to teaching

[2] Adaptation of Lafortune, 2001:91-96

	approaches recommended by socioconstructivism. 6. In a group discussion, stress the reasons why a specific pedagogical method seems to favour one learning model over another.
Role of moderator	▪ To pay attention to what is expressed, without being judgmental. ▪ To promote communication. ▪ To encourage personal reflection on our own pedagogical practices. ▪ To present other visions of teaching so as to enrich participants' construction of knowledge.
Role of participants	▪ To participate actively in exchanges with others. ▪ To engage themselves personally in metacognitive reflection.
Pedagogical material	▪ Tool 7.A: Methods of teaching: a guide to self-reflection ▪ Tool 7.B: A signature for a teaching style ▪ Tool 7.C: Methods and their connection to the socioconstructivist model
Supporting documentation	Document 15: Learning and teaching strategies Document 16: Strategic teaching measures Document 17: A frame of reference for strategic teaching Document 18: Ten fields of competency recognized as a priority in the continuing education of professors Document 20: Multiple intelligences
Comment	The supporting documentation contains additional information for the documentation used in the activity.
Approximate duration	Three hours. This does not include reading the supporting documentation as an extension of the activity.

Activity 8

Title	**A concept of competency**
Objectives	▪ To establish the essential characteristics of a competency. ▪ To evaluate the impact on teaching of the principles emanating from the nature of a competency.
Learning process	Stage *of Elaboration*: the learner establishes links between what he knows, what he learns and what he seeks to understand.
Description	Learning at the collegial level means developing competency. The construction of knowledge favours a pedagogical environment characterized by a high degree of complexity. Contexts characterized by complexity require entry by competency when knowledge is subordinated to the competency itself. This activity offers an opportunity to validate our own idea of competency and identify characteristics which influence teaching. This project is concluded with a discussion on the principles resulting from the nature of a competency and their impact on teaching.
Unfolding	1. Individually, participants establish the characteristics of a competency based on various definitions of a competency (Tool 8.A). Your own personal definition (Tool 8.B). 2. Pooling of personal definitions. Participants try to reach consensus on the characteristics using Tool 8.C. Producing a schema would also be extremely appropriate to illustrate the different characteristics. *3.* Individually, participants complete the form in Tool 8.D on the *principles arising from the nature of competencies and their impact on my teaching.* 4. Pooling: characterize what seems the most useful for the teaching of competencies. 5. Synthesis and evaluation of the learning.
Role of moderator	▪ To promote personal reflection. ▪ To achieve consensus. ▪ To use strategies that help structure knowledge.
Role of participants	▪ To express their own concepts freely. ▪ To commit themselves to group discussions, to compare and validate their own concepts.
Pedagogical material	▪ Tool 8.A: What are the essential characteristics of competencies as a learning objective? ▪ Tool 8.B: What is your definition of a competency? Similarities and differences with other definitions?

	▪ Tool 8.C: Characteristics of a competency ▪ Tool 8.D: Principles arising from the nature of competencies and their impact on my teaching
Supporting documentation	Document 7:Differentiating various types of knowledge Document 8: Categories of knowledge Document 9: The learning of competencies within the school environment Document 10: Principles pursuant to the nature of a competency
Approximate duration	Two hours. This does not include reading the supporting documentation as an extension of the activity.

Activity 9

Title	**Learning by problem situation**
Objectives	▪ To know what problem-based learning is. ▪ To use a problem situation as an activity.
Learning process	Stage *of Application*: to use our own knowledge in the implementation of acquisitions relative to the development of our own competency.
Description	Description of the problem situation of this activity. "For two years, the success rate in a study program has dropped by 7%. Following an analysis by the program team, several assumptions were retained to correct the situation. One is to invest more time in new educational strategies that support better learning. As members of a special committee elected by the program team, you are charged with recommending new learning strategies, particularly problem-based learning, and to convince your colleagues of the benefits of such a pedagogical method."
Unfolding	1. Presentation of the theme: understanding the mandate, evaluation of what is at stake. 2. Personal reflection: each individual writes in a few words: - what he knows about the learning strategies proposed in the mandate. - what he proposes for the study of problem-based learning- my first arguments to convince my colleagues of the benefits of such a pedagogy. 3. Division of the group in teams of 4 or 5 people 4. Drafting of common propositions: 4.1 Description of a problem situation and examples (tool 9.A). 4.2 Acquisition of the instructions to work out a situation problem (Tool 9.B). 4.3 Study of the characteristics and advantages of using this learning strategy (Tool 9.C). 4.4 Study of the problem situation example used for this activity (Tool 9.D). 4.5 Drafting of common propositions to convince the colleagues of the teaching benefits of such a pedagogy. 5. Pooling: 5.1 Each group presents its propositions and justifies them. 5.2 Compilation of the presentations of each group. 6. Synthesis: group discussion to synthesize the various team presentations. 7. Evaluation of personal learning.

Role of moderator	▪ To facilitate the engagement of participants. ▪ To present the instructions explicitly. ▪ To support interactions within teams.
Role of participants	▪ To engage actively in the activities. ▪ To carry out the tasks reserved for them. ▪ To be attentive to their own learning strategies.
Pedagogical material	Tool 9.A: A problem situation, what and why Tool 9.B: Problem situations: French at secondary level Tool 9.C: Characteristics of a problem situation Tool 9.D: Learning by problem situation
Supporting documentation	Document 19: Methodological guide for elaborating a problem situation Document 21: Problem-based learning Document 22: From theory to practice. Bank of methodological tools. The problem situation
Approximate duration	From two to three hours. This does not include reading the supporting documentation as an extension of the activity.

Activity 10

Title	**To apply a typical learning process**
Objectives	▪ To plan a teaching sequence based on the cognitivist theory. ▪ To write a lesson plan.
Learning process	Stage *of Integration*, to support the transfer of acquisitions to increasingly new situations.
Description	To write a lesson plan based on the application of a typical learning process.
Unfolding	1. To form teams of 4 people. 2. To individually review the problem situation (Tool 10.A). 3. Discussion on the comprehension of the mandate. 4. To establish a work plan for the team. 5. To complete the proposed form (Tool 10.B). 6. To present this report to the group. 7. To collectively evaluate the meeting and the learning.
Role of moderator	▪ To explain the instructions clearly and clarify the task. ▪ To answer all requests for information. ▪ To facilitate interactions within the teams. ▪ To provide feedback on both the process and the product.
Role of participants	▪ To engage actively in the activity. ▪ To cooperate toward the completion of the task. ▪ To openly express their own concepts and opinions.
Pedagogical material	Tool 10.A: Problem situation: to write a lesson plan Tool 10.B: Form for lesson planning Tool 10.C: A typical learning process and sequence of interventions associated with a typical process from a cognitivist perspective.
Supporting documentation	See **Additional Resources**: Document 4.2: Practical consequences of cognitivist theories Tool 3.A: Guiding principles in professional practices Tool 3.B: Synthesis and professional practices relating to behaviourist and constructivist movements *Tool* 6.C: The learner at the heart of teaching
Comment	The completion of this activity implies the participation in prior activities. Some declarative and procedural knowledge is necessary to produce the lesson plan, but the participants' prior experience in

	lesson planning makes it possible to carry out the activity within the required time frame. The problem situation allows for complete flexibility as to the means used to solve the problem.
Approximate duration	Three hours. It is recommended that the pedagogical material be placed at the disposal of participants before the activity. This does not include reading the supporting documentation as an extension of the activity.

Activity 11

Title	**Possible paths to the creation of learning activities**
Objectives	1. To recognize the pedagogical principles present in our own practices. 2. To compare our pedagogical practices with those of others. 3. To identify improvements to our own professional practice.
Learning process	Stage *of Elaborations*: to understand based on our own experience. And *Organization*, to establish links between our own practices and pedagogical principles.
Description	Within an educational perspective, it seems essential to occasionally stop and take stock of the underlying principles that guide our pedagogical practices. Initially, participants identify possible paths leading to the creation of learning tasks. In the second part of the activity, participants reflect on conditions favourable to learning. By reflecting on various pedagogical principles and by discussing these with colleagues, we realize that some practices seem highly beneficial and thus, we may wish to incorporate them into out own practices.
Unfolding	1. Period of initial reflection: to better define our own pedagogical practices. Individually, each participant identifies the principles which guide the creation of learning tasks. 2. Pooling of personal reflections. 3. Use of Tool 11.A, and work in teams: 3.1 The pedagogical principles are presented one by one. 3.2 Discussion on the comprehension of the principle. 3.3 Participants share their personal experience as to the integration of each principle in their professional practice. 3.4 Possible paths for taking action are identified so as to improve our own practice. 4. In the second part, discussions continue on conditions favourable to learning, using Tool 11.B. 4.1 The favourable conditions are presented one by one. 4.2 The understanding of each condition is discussed. 4.3 Each participant shares his personal experience as to the integration of each condition in his practice. 4.4 Possible leads for taking action are identified to improve our own practice. 5. Pooling of information and discussion of the question: “I am

	teaching, but are they learning?” 6. Evaluation of the learning.
Role of moderator	▪ To support communication. ▪ To encourage a personal reflection on our own pedagogical practices. ▪ To present the principles and the conditions favourable to learning in order to enrich the knowledge of participants.
Role of participants	▪ To take an active part in the exchanges between participants. ▪ To engage themselves personally in a metacognitive reflection.
Pedagogical material	▪ Tool 11.A: Five ways to create learning activities for students ▪ Tool 11.B: Five conditions conducive to learning
Supporting documentation	Document 3: Learning principles Document 5: Educational principles behind the implementation of study programs
Approximate duration	Approximately two hours

Section III

Support tools

Support tools are necessary for carrying out the sensitization activities. They help define the unfolding of the activity, provide instructions for completing it, and introduce documents and texts that help moderate the various activities.

Different support tools correspond to different sensitization activities.

For example:

- For Activity 1, use: Support tool 1.A and 1.B
- For Activity 2, use: Support tool 2
- Etc.

Support tool 1.A
Prior knowledge

Presentation

In *Le Bourgeois Gentilhomme* by French playwright Molière, a 'nouveau riche' named Jordan, aspires to be part of the aristocracy. Along the way, however, he makes an important discovery: "I am prosaic. I have always been prosaic. I have been prosaic all my life". This sudden self-awareness highlights the fact that our actions are not always guided by a conscious understanding of their meaning. This is why professors often adopt a specific teaching approach or method without necessarily knowing on which theory it is based or to which frame of reference it may relate. Intuition, past successes and observation play an important role in the behaviour of professors; in fact, these elements often become the dictates of their professional practice.

The fact that a given teaching practice can be linked to a theory without being directly or knowingly guided by it, underscores the complexity of the relationship between theory and practice. It seems that the more a theory is general in scope, the easier it is to apply directly or indirectly to practice. An expert rarely restricts himself to one teaching and learning approach and usually chooses methods that do not have a direct connection to any single theory of learning. Several even adopt teaching formulas that encompass several learning models.

Before presenting current learning models, let us examine the knowledge that teachers may have on these models.

"Many teachers in training believe that the concept of prior knowledge means knowledge acquired during preceding courses. This reflects an incomplete comprehension of the knowledge base that anchors learning. Astolfi (1992) states "that before any teaching occurs, it is vital to identify what learning model the student already possesses, and if this model coincides with the new one." Research has shown that a learning model is forged through experience, imagination, feelings, information, etc., and, it can be partially accurate, completely accurate or erroneous. This is what we refer to when we say that the construction of personal knowledge rests on the prior knowledge of the learner."[3]

The personal construction of knowledge rests primarily on the prior knowledge acquired by the learner. Prior knowledge acts as a filter in the processing of data and in determining the degree of credibility given to the new information. This filter can also transform knowledge into something that will be stored until the summative evaluation, after which it will become inoperative or completely discarded. Recognition of prior knowledge provides advantages on the emotional plane: this recognition helps provide an objective view of our evolving competencies; it can help us avoid the negative energy that results from thinking the new learning is "just more of the same."

Instructions for carrying out the activity

[3] Tardif, Jacques, *Intégrer les nouvelles technologies de l'information*, ESF éditeur. p.44, 1998

1. General presentation using the preceding text.
2. Individual reading to stimulate reflection. Suggested reading “Teaching is not learning" (Support tool 1.B). This text could also be used as a synthesis at the end of the learning activity; it is up to the discretion of the moderator.
3. Individually, each participant identifies what he knows about learning models and educational approaches (duration: 15 minutes).
   3.1. To stimulate reflection, each participant thinks back on all the choices that have guided his teaching practices; on the learning theories he is familiar with; the beliefs which are the basis of his professional practice; the learning principles which guide his choice of learning activities; and, finally, which teaching formulas he favours.
4. Teams of 3 or 4 people are formed. Discussion, exchange of ideas on the results of the previous step. Using the notes taken by participants, a **pedagogical poster** is produced that itemizes the beliefs and knowledge they have of the learning models that reflect their pedagogical thinking.

   Only one poster per team.
5. All posters are displayed on the walls of the meeting room. Participants circulate to familiarize themselves with the contents of other teams’ posters.
6. Working all together, participants create a collective poster identifying the spontaneous ideas that reflect the pedagogical thinking of the group.

Support tool 1.B

Teaching is not learning

By André Giordan [4]

A student already has concepts, albeit more or less adequate, on the questions he will be studying. The teacher must take this into account and create the conditions for self-learning.

Teaching does not necessarily mean making someone learn. We've been saying this for 10 years now. It is quite the opposite. For all sorts of reasons, teaching can block learning. Worse yet, teaching can bore a student, stifle his motivation and prevent his progress. Teachers keep saying that "students don't want to study anymore", without however looking into the reasons behind this attitude.

Our research, known as "allosteric learning", shows that people learn through what they are and from the knowledge they have already acquired. Before taking any course, the learner already possesses masses of questions, ideas, and ways of reasoning on society, school, knowledge, the environment and the universe. All these elements condition his approach. These concepts, as we call them, present a certain amount of stability.

The acquisition of knowledge and thought processes depends entirely on these concepts. When the schooling system does not take this fact into account, these concepts remain in place and the new content goes right over the head of the students without ever entering. Contrary to popular belief, teaching is not something straightforward or easy. In any case, nothing can be learned by direct teacher-student transmission or through memorization by the student. The student himself needs to understand, learn and mobilize the information; and no one can do it for him.

Only the learner can construct his knowledge bit by bit. To do this, he must rely on his own ideas and thought processes.

---

[4] Excerpt from: Giordan, André, http://www.ldes.unige.ch/ang/publi/articles/IUBS_AG_97/IUBS97.htm and http://www.ldes.unige.ch/ang/publi/articles/beyond-AG-95/beyconst.htm and http://www.ldes.unige.ch/ang/rech/th_appGB.htm http://www.ldes.unige.ch/ang/rech/i_rech.htm

However, this process can be facilitated indirectly by an allosteric environment, which is a paradox that schooling must cope with today. Schools must facilitate the conditions of self-teaching. Knowledge is only mobilized when it acquires meaning for the learner. To achieve this, teaching has an active role to play by making it possible for the learner to be confronted with challenging learning situations, information and tools (symbols, diagrams, models, concepts…) that help him think.

How can we create urgently needed conditions of self-teaching? First, we must reduce the number of hours in class where the student sits passively in front of the professor. The school must support activities of investigation, self-documentation, the confrontation of ideas, as well as the elaboration and production of work by the students themselves. The professor is the creator of the learning conditions. His role is to motivate the students, to guide them in the acquisition of skills and to provide them with reference points or approaches and support tools. He must also act upon the concepts of the students so that they may move beyond these concepts. It is necessary to question and discuss ideas, frames of reference and the logic of the learners. It is out of the question for the learner to remain inert.

To define our approach we use the term allosteric learning. "Allosteric learning" is a chemical metaphor which refers to the structure and function of certain “allosteric” proteins. English and American researchers, who are very interested in the pragmatic aspects of our ideas, used the phrase 'allosteric learning model' and confirmed that we were the originators of the approach.

FOR A VERY LONG TIME NOW, one of the primary foundations of education can best be described using a statement popularised by Condillac whereby “a child is like soft wax that needs to be given shape".

REASONING "ERRORS" OR "ERRONEOUS" NOTIONS of students persist with baffling regularity, even after numerous teaching courses.

STUDENTS’ “CONCEPTIONS”

Explanations are not enough

Faced with an error based on a prior concept and not due to the simple ignorance of specific knowledge, any explanation provided by the professor is ineffective.

The professor can adopt a number of attitudes relative to the concepts the students already have. He can:

- "*do without*" as do 99% of pedagogues, by using a dogmatic or professorial approach with the class. This practice yields mediocre results;
- "*work with* " by advocating free expression;
- *" work against”* while trying to convince the learner that he is mistaken and then offering the "appropriate knowledge".
  The idea that we develop throughout our allosteric learning model is that he must
- “*work with to work against* ", which is not contradictory in the present context.

To "*work with*", the teacher creates a starting point by encouraging students to express their concepts and ask questions. Working in groups or with the entire class, he introduces the students to opposing concepts. This confrontation leads the students to take a step back, elaborate on their concepts or debate them and sometimes reformulate them.

These developments can be completed and enriched by means of investigations. Students are encouraged to observe, experiment when the contents allow it, investigate, or do mediation work on documents (books, articles, videos and eventually, films).
To "work with" prior concepts goes against traditional practices. Here, teaching begins with the learner and avoids any conditioning. The student tries to go beyond his concepts via searching and debating. This pedagogy is very useful for initiation into a field and works as efficiently with young children as with adults.

Using conceptions

This practice restores and stimulates curiosity, reinforces self-confidence, develops communication and encourages the learner to identify objectives he wants to reach, according to his own interests. It even constitutes an essential stage in ridding oneself of inhibitions. It also plays an interesting role in situations that call for sharing experiences or confronting different viewpoints. However this approach quickly shows its limitations. It does not bring about a surpassing of prior concepts. The acquisition of new basic concepts or new ways of thinking is seldom possible. This is due to the fact that this approach assumes continuity between familiar knowledge and concepts and that a subject can pass from one to the other without any cuts or ruptures.

To learn does not only mean to enrich our concepts. Many obstacles hinder this enrichment. In order to go beyond concepts after they have been identified as the underlying cause of various obstacles, some authors eliminate them or "*go against*" them. Philosopher Gaston Bachelard had this to say on the subject: "It is not a question of acquiring culture but of changing culture, of overcoming obstacles accumulated in everyday life". To him, a "corrective" education approach seems more appropriate.

A question immediately comes to mind: Can we "destroy" a prior concept by providing a correct answer? It seems logical that having located an error, the teacher, will try to correct it while stressing the points he feels are problematic. We have all done this. However after several attempts and ensuing evaluations, we come to the conclusion that it has all been in vain.

When an error corresponds to an underlying concept and is not the mere ignorance of some specific knowledge, it is utopian to believe that an explanation provided by a professor (regardless of how accurate) will systematically solve the problem. Teachers continue to find this surprising because, according to them, their comments appear coherent, simple to understand and clearly well-adapted. For instance, when the teaching is completed in a course on the structure of the digestive system, what really remains? Faced with poor results, Migne, an educator from Nancy, proposed a more detailed explanation. He went back to Bachelard's idea that "the transition from mental representation to concept can be achieved only with the elimination of subjective elements". Then he added an element which he felt,

made it possible to solve the enigma: he stated that we must allow for the "emergence of representations" so that "exact knowledge" can be provided by the learner; thus allowing us to "to point out the errors in the original representation, and identify why they exist".

We tested this procedure with several subjects and in classrooms at different levels (from primary to finishing schools and also in adult education). The results were very disappointing. This procedure may interest trainers who want to develop critical thinking, but it proved ineffective for the development of better constructed knowledge.

The idea "of dismantling original concepts" to better destroy them and then in the final act provide the "true knowledge", corresponds to the 'expert' approach. The learner remains passive and has to learn what the teacher chooses for him to learn. However, it is the student who has constructed his own concepts and who must continue to be the principal actor in his transformation; he must decide on the best replacement concept. Our research on concepts has uncovered many obstacles. They should be approached gradually without skipping any steps. It is utopian to think that a "good accurate explanation" and our insistence on it, is sufficient to transform a concept. A person convinced against their will is of the same opinion still.

This does not mean that a professor should avoid using learning models. He must simply remember that a message can only be understood directly by a student when the latter asks himself the same question and uses the same frame of reference.

Obstacles to the evolution of concepts

There are many obstacles to the evolution of concepts in the learner. The main ones are:

1. The learner lacks information.
2. The learner does not want to alter his concepts.
3. He does not relate to the problem situation.
4. The questions he asks are not the same as those raised by the teacher.
5. The learner does not ask questions because he believes he already possesses the knowledge.
6. He thinks he understands or has a sufficient grasp of some "words" to think he understands.
7. He has knowledge that has proven effective in other situations; he is therefore satisfied and does not seek to go beyond this knowledge.
8. The learner has preconceived ideas that hinder his perception of the reality of the phenomenon and his integration of new information that goes against these ideas.
9. The learner does not have the support tools necessary for integration (cognitive capacities, strategies, peripheral knowledge) to understand what is being presented.

To validate these obstacles, ask your students to visualize the operations of a water treatment plant, a wind mill… Ask them to provide as much detailed information as possible.

Ask questions (written or oral) on daily occurrences in the student's life: What happens to waste that we put in garbage pails? Who decides when and how a road will be built?

Support tool 2
The diagram of a concept

2.1 General presentation

2.2 Nature of a concept[5]

What is a concept? The dictionary defines concept as "a general mental learning model abstracted from an object". For the purposes of this discussion, let us extend the definition to include a consistency among objects or events that creates a meaningful entity. Thus the concept of sound includes all that we have heard, read and experienced about sound. In an adult, the concept of sound is more detailed, complete and varied than in a newborn who has only heard hospital sounds. Humans invent concepts during childhood that are later expressed in a language that unifies thinking and facilitates communication. We create conceptual categories by grouping ideas which resemble each other. In a child for example, the idea of "dog" evolves from family pet to part of a whole race"; seeing ten different breeds of dogs in the neighbourhood facilitates this recognition.

We build hierarchical structures of concepts as soon as we start to understand the relationship between them. We learn that *animal* is a concept that contains fish, insects, reptiles, amphibians, mammals and birds (in the game 20 questions, we ask "Is it animal, mineral or vegetable?"). It is the hierarchical structure that our culture accepts and we learn it very early in school.

Concepts can be concrete, i.e., connected to a physical object such as a table, an ice cube, a tree; or abstract, i.e., art, harmony and beauty. Generally, the most abstract concepts like evolution, life, personality and health occupy the top levels in a hierarchy of concepts. For example, energy is considered the highest concept of all in science; it governs all scientific relationships.

2.3 A conceptual diagram

To which reality does a conceptual diagram correspond? The diagram refers to an organic schema that tries to represent the conceptual structure of one or more knowledge modules in a specific study domain. Traditionally, knowledge was visualized as sequential, like a storybook; as a list written on a blackboard or projected on screen using an overhead projector and acetates. For example, a table of contents is a one-dimensional list, which does not show the organic links connecting the ideas and the subjects to each other. Conversely, a diagram constitutes a two-dimensional schema including both the concepts and the relationships between them. The relationships are visualized through the use of words written on the lines which connect them. The diagram in Figure 13-1 is the result of work done by a fourth year co-ed student in science of education within the framework of a planning exercise for teaching a subject to a grade four class at elementary level. She used a rather unorthodox approach to the subject matter. We may not agree with her method of establishing relationships between concepts or some of her ideas, but this first version helped to create a

[5] Translated from HENEMAND, Jacques, GAGNON, Dolorès, *Devenir enseignant*, tome2 : *D'une expérience de survie à la maîtrise d'une pratique professionnelle*, éditions Logiques, Montréal, chapter 13

more precise image of the subject that would be presented to the students. Figure 13-2 is a revised version of these ideas, presented in a more appropriate manner.

Figure 13.1
Initial outline of a conceptual diagram

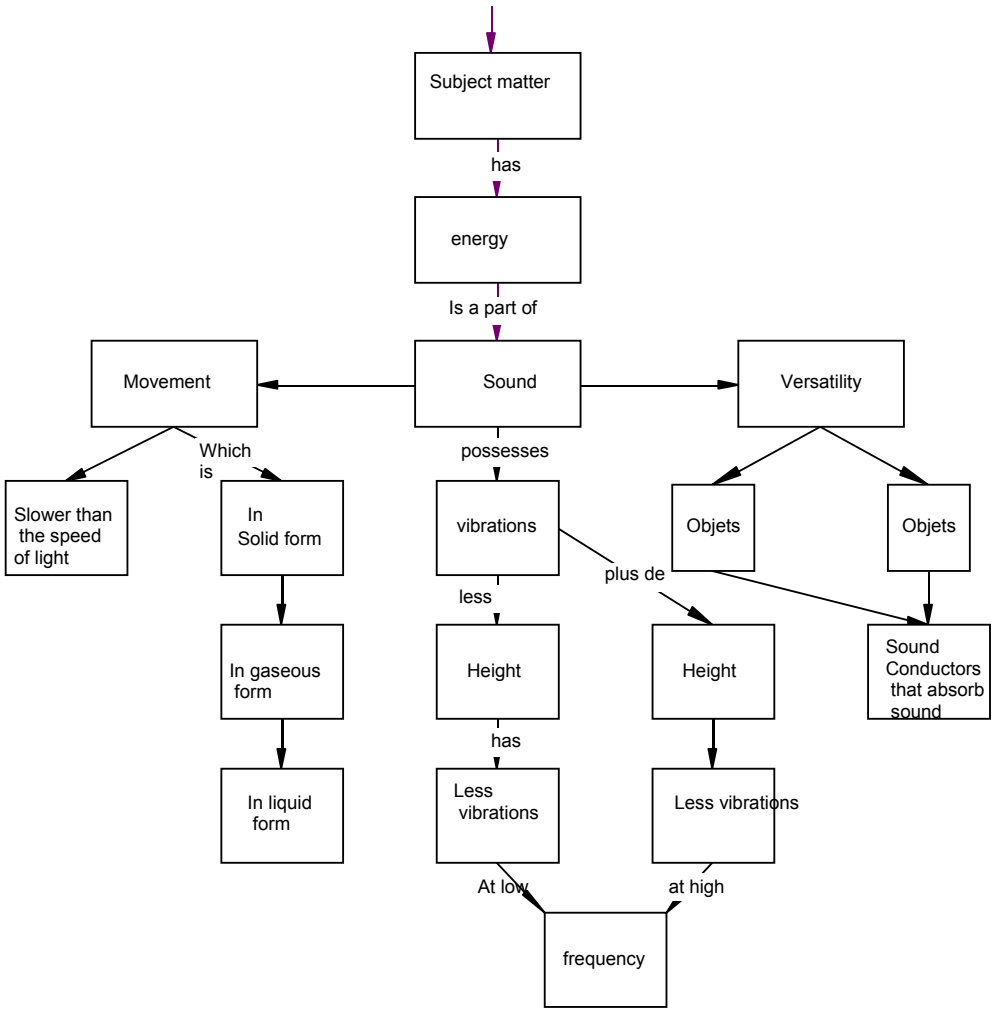
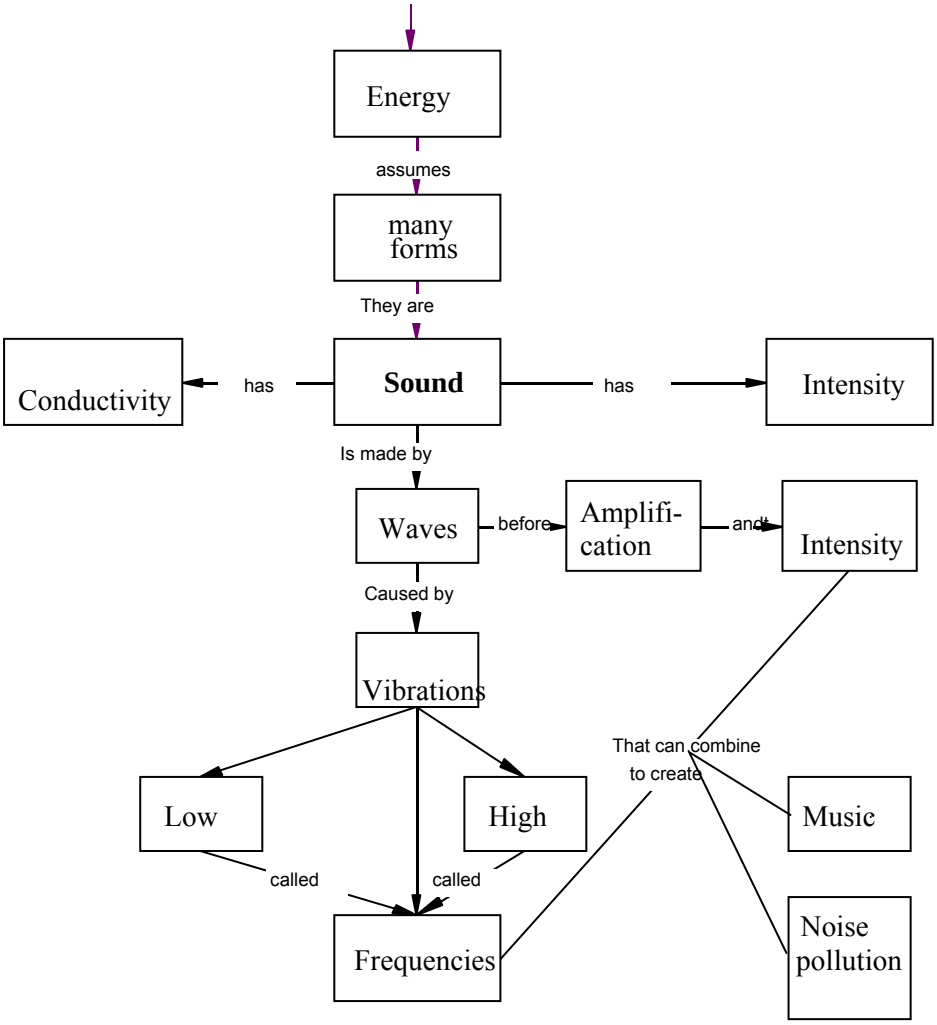


Figure 13.2
Revised diagram of a concept



2.4 Production stages of a conceptual diagram

1. Produce a diagram of the concept provided below.
   In the following paragraph, select two general abstract concepts and two specific concepts. Underline them.

   > *"Everything that lives needs energy. Plants and animals require energy for their vital needs. Certain vital needs common to plants and animals are growth, reproduction, breathing and the transport of materials. Only green plants produce food. Animals cannot produce their own food; therefore they need to search to find their food."*

2. On a sheet of paper, insert each of these four concepts into a rectangle, placing the most general and abstract concepts at the top of the page and the most specific ones at the bottom. Separate the concepts so that you can add connecting lines to show a relationship and also include descriptors for the lines. You may want to assign a similar rank to concepts by placing them at the same horizontal level.

3. Draw the connecting lines between the rectangles and add a descriptor for what links them. This stage is crucial and can include the rearrangement of the concepts. The relationships are usually expressed by verbs and are read from top to bottom, to respect their hierarchical structure. Try to establish the greatest number of links possible, but do not cross the lines of already established connections.

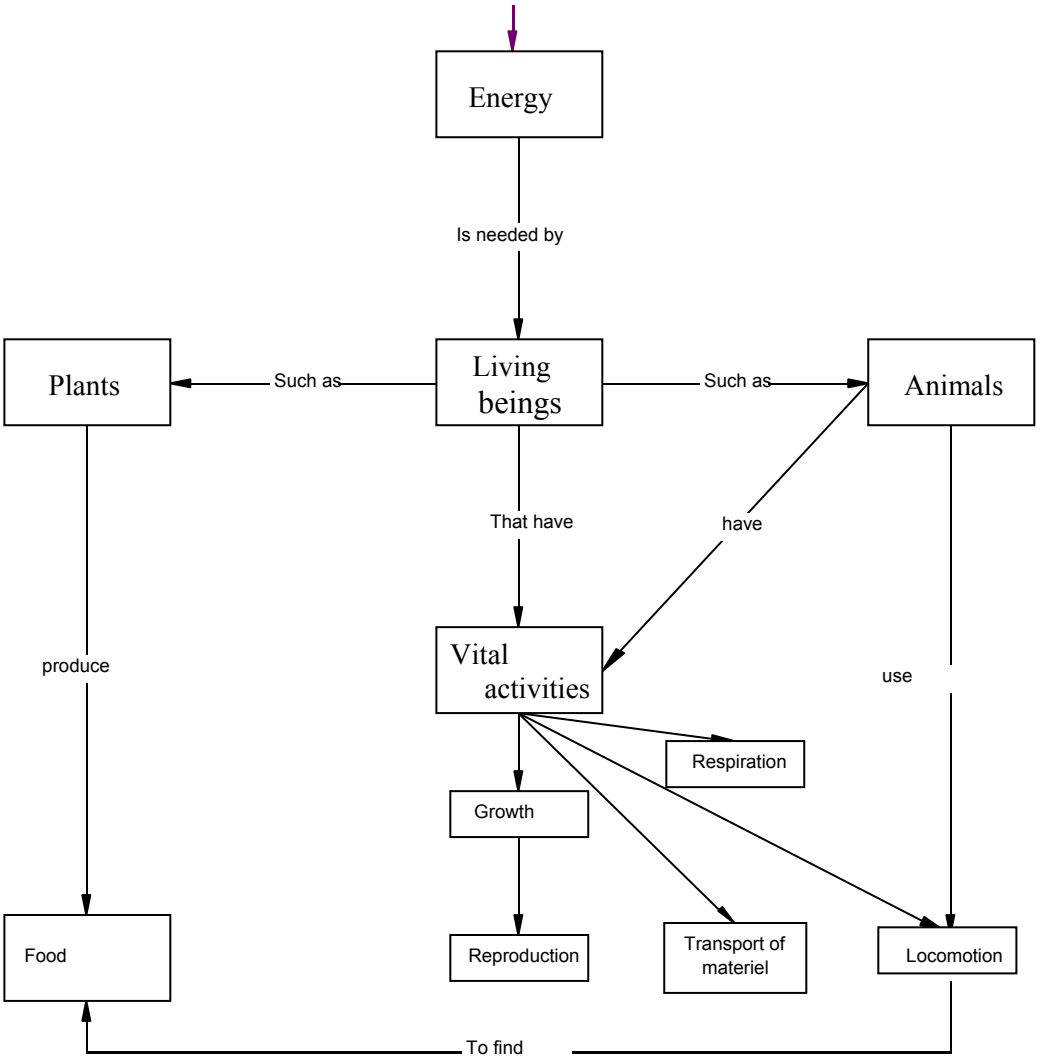
4. Compare your diagram to that of another participant and discuss what distinguishes them. Make sure that the most important general abstract concepts are at the top, and the concrete situations and illustrations are at the bottom of the sheet.

5. Now, return to the initial paragraph, underline four additional concepts, and repeat steps 2 and 3.

6. Presentation of some of the diagrams to the participants, followed by a discussion on the diagram presented by the moderator (see next page).

7. Group discussion on the use, relevance and procedures to create conceptual diagrams.

Figure 13.3
Sample diagram of a concept



Support tool 3.A
The behaviourist concept

Behaviourism [6] considers learning to be a long-lasting change in *behaviour* that results from specific instruction. The mechanism of acquisition is based on *conditioning,* a theory whereby learning consists in establishing a stable relationship between the desired response and a s*timulus* from the environment, using positive and negative *reinforcement.* Motivation, repetition and positive reinforcement of the correct response are the essential ingredients to learning. To obtain the desired behaviour, the learning task is divided into units of behaviour and *a reinforcement program* is designed to direct the action towards the target stimuli (*discriminative learning*). Repetition then makes it possible to ensure the stimulus-response association.

Behaviourism focuses intently on the length of time between student response and the reinforcement given by the professor. Many experimental studies show that the shorter the interval, the better the final *performance*. For example, a three-week delay in returning copies does not encourage the student to change his behaviour. In current teaching practices, this idea is translated into "real time" evaluations based on the following scenario: presentation of the concept, training exercise, evaluation of what the students learned so as to adapt the next lesson to the results obtained. One of the consequences of this type of practice is the disappearance of "lengthy writing projects" in and outside of the classroom.

The *behaviourist* theories found a home in programmed instruction which targets *error free learning* through a gradual progression of behavioural units. *Teaching machines* (ancestors of computers) proposed by Skinner were built to provide reinforcements adapted to each student. They would ensure the *individualized instruction* that the teacher could not.

For behaviourists, learning is the result of teaching that provides forms adapted to the students' needs. Teaching must develop into a system of education that is "almost without error". (2). The quality of teaching consists in providing students with stimulating cases, adapted reinforcements, corrective feedback in the form of *formative evaluations*. The latter consists of putting into place an instruction program that ensures that all students achieve the objectives. Thus, behaviourism provides teaching with support tools like *mastery learning* and *formative evaluation* to ensure the student is learning. Learning is defined as the time needed to reach a precise objective for a given level of mastery (for example, the cyclic organization at elementary level). The temporal variable is essential in learning. For example, many experimental studies have shown that instruction *distributed* over time produces better learning than tightly massed instruction (for example, courses that are grouped). From a teaching viewpoint, the essential reference point is the tutor since only he can individualize the learning path and take into account the needs of each student.

Taken from AMIGUES, René, Enseignement-apprentissage, http://www.aix-mrs.iufm.fr/services/communication/publications/vocabulaire/n1/roux/index.html

Support tool 3.B
Cognitivism

The cognitive approach originated in cognitive psychology and was largely influenced by theories in data processing. This took place during the late 70's and has now become known as cognitive science.

Cognitive psychology seeks to answer questions relating to the nature of knowledge, its components, origin and development. "On one hand, it is concerned by the learning strategies of the student, gradual construction of knowledge in memory and conditions for recalling knowledge. In addition, it is preoccupied by research on teaching strategies most apt to support gradual construction of knowledge in the student, based on his affective, cognitive and metacognitive state, and relative to the inherent logic of the learning task. Knowledge stored by the student in long-term memory is not just a photocopy of the information given to him externally by the teacher, but a construction built on prior knowledge already stored there, to which he is now assimilating new information. This construction process causes the student to make a selection among the whole, to do some editing."(Tardif, 1992: 28)

Discoveries about the brain and learning have altered our concepts of learning and teaching. They challenge our professional roles and actions and force us to take a fresh new look at those who are learning.

Table 1 below introduces concepts of cognitive psychology on a few of the dimensions involved in teaching/learning.

2.4.1.1.1 Conceptions of cognitive psychology

Conception of learning	• Learning occurs through the gradual construction of knowledge. • Learning occurs through the interaction between prior knowledge and new information. • Learning occurs when knowledge is structured. • Learning occurs through the use of complete tasks.
2.4.1.1.2 Conception of the 2.4.1.1.3 Student	• The student is active. • The student acts in a constructive manner.
2.4.1.1.3.1.1 2.4.1.1.3.1.2 Conception of teaching	• Creation of an environment starting from student's prior knowledge. • Creation of an environment centered on cognitive and metacognitive strategies. • Creation of an environment with complete and complex tasks.
Conception of the teacher's role	• The teacher intervenes frequently. • The teacher is an instructor. • The teacher is a mediator between knowledge and the student.
Conception on evaluation	• Evaluation is frequent. • Evaluation relates to knowledge as well as to cognitive and metacognitive strategies. • Evaluation is often formative, sometimes summative. • Feedback focuses on the strategy being used. • Feedback focuses on the construction of knowledge.

Pôle de l'Est (1996)

From *the cognitive* perspective, the learner's prior knowledge takes precedence over the new data, and the first knowledge to which the student is confronted is his own prior knowledge. This knowledge is processed initially, while he tries to give meaning to the new information in front of him.

Learning is *a process*: knowledge is integrated during a succession of activities carried out by the learner to acquire knowledge; and *a product*: a modification of the structure of the learner's knowledge.

What characterizes cognitive psychology is that it compares learning, the act of acquiring and using knowledge, to a data processing system.

Teaching and learning involve distinct approaches to data processing for the teacher and the student. Also, from a cognitive standpoint, whereas the teacher processes data related to the contents of the domain of study and classroom management as well as the emotional and cognitive components of the student, the student processes emotional, cognitive and metacognitive information.

"The student processes emotional data which often comes from previous school experiences and is now activated by the learning task at hand. This information relates to recognition of the goals sought by the teacher, the value he allots to the learning task and his perception of his level of control over his success. The student also processes cognitive data. To ensure comprehension, he combines the information provided by the teacher and his prior knowledge and actively constructs the new knowledge. By processing cognitive data, he chooses the strategies which offer the highest probability of learning to carry out the learning task adequately and to master the learning. He plans the stages needed to achieve his task. At a third level of operation, the student processes metacognitive data[7]"(Tardif, 1992: 27)

[7] Me*tacognition* refers to knowledge and the control exerted on oneself and one's own cognitive processes. It deals with a capacity to manage one's comprehension and emotional capacities relative to attentiveness, stress and level of involvement in the achievement of a task.

Support tool 3.C

Historico-cultural or sociohistoric approach (Vygotsky)

The historico-cultural approach[8] suggested by Vygotsky is the only theoretical movement whose objective was not the study of the relationship between teaching and the development of intelligence through "instrumental" rationality. The main idea could be summed up this way: *teaching* is a process of cultural transmission which generates *the development* of mental abilities, not yet controlled by the students, who build it through the *learning* of specific tools that constitute human works (literary, scientific, artistic…), the cultural transmission of which is largely devolved to schools.

.

According to Vygotsky, skills that are taught ("scientific concepts") are different from familiar ideas ("daily concepts") built through practical experience. The former are products of human activity, "creative works" – literary, scientific, artistic… - socially elaborate, historically dated and culturally transmitted in schools. The question is not to oppose these two concepts but rather focus on what differs in their modes of transmission and acquisition.

The school delivers grouped instruction (language, math, biology…) and "written" instruction through the use of a variety of writings (texts, symbols, plans, charts, tables…). However, this engenders at once a particular difficulty and a change in the student's relationship with the world. To know the world, the student does not act directly on the physical reality that surrounds him but rather through the learning models of the world he has built to understand it. His relationship to time and space for instance, cannot be conceived independently of the support tools used to appreciate it (egg timer, calendar, watch, metric system…). The school delivers "learning tools" so the child may *mediate* with the world, others and himself.

The thesis Vygotsky puts forth is that the human psyche has a social nature and that intellectual functions develop by using these "tools" or "systems of signs", with language at the top of the list. This historico-cultural approach (or sociohistoric, as per the authors) differs from behaviourist reductionism, "immediacy" and "pragmatism". It also differs from Piaget's constructivism of which it rejects the "internalized" explanations. The cultural transmission occurring in schools is the source of both intellectual education and socialization. In order to explain in detail this process, the sociohistoric approach studies semiotic activities and the *processes of mediation* in *teaching-learning* situations.

The transfer of skills in school differs from current social practices (family, on-the-job training). This is why school cases are described as "artificial" versus "natural" cases. As a result, social relations must be reconsidered from the standpoint of formal education. B. Lahire speaks about "pedagogization of social relations", to indicate not only the asymmetrical relationship between the professor and the student but also the didactic dialogue, which differs from the more familiar linguistic forms. This framework of exchange is also a way of thinking about our *relationship with knowledge* and others. It is within this

[8] Taken from AMIGUES, René, Enseignement-apprentissage, http://www.aix-mrs.iufm.fr/services/communication/publications/vocabulaire/n1/roux/index.html

framework that the professor and the students interact as part of a collective work group or *classroom-group.*

The teacher must create an educational environment suitable for the group of students. He not only manages the symbolic and technological environment for the construction of a collective answer, he also creates the conditions for a didactic dialogue: professor/ collective, clarifications, confrontations between student viewpoints, reformulation and rewriting of prior knowledge, etc. The *didactic dialogue* is the discursive development which enables reflexive work on actions, critical analysis, distancing and awareness of the reasons why we act one way and not another. It is a teaching technique that prepares students to study a specific subject matter and engages them in a participatory process.

The teaching process situates learning in a temporal context, which means that the processing of current knowledge is linked to its past but it must also have a relationship with what its future. In other words, progression at school assumes a permanent transformation of memory into active thought, the progressive construction of support tools for control and mobilization which Vygotsky calls *higher psychological functions* (language, memory, attention, will, verbal thought…). By using case studies spread over time, the professor is constrained "to manage" both the "continuity" of learning and its "dismantling" to motivate the student to go beyond his capabilities. This in turn leads to the *zone of proximal development*.

This paradox of continuity/dismantling is characteristic of the transmission-acquisition process which transforms action-related constraints into cognitive resources used by the *classroom-group*. For example, in the classroom the student constructs a rational answer (and explains his actions relative to a semiotic system (grammar, algebra…) validated by someone other than himself (society, "official" grammar, the algebra taught…) and accepted socially by the *classroom-group*. To publicly state "how and with what" he thinks, the student must use "tools of thought" that have developed over preceding generations. These *social meanings* are then the topic of discussion and sharing among students. The constraint "to publicize the use of social meanings" constitutes a cognitive resource for the student and the group. This is why the student must initially reason with others (professor and students) before thinking for and by himself. It is on this passage from *interpsychical* to *intrapsychical* that *socioconstructivism* has focused primarily.

Support tool 3.D
Constructivism

Constructivism[9] views learning as a process whereby knowledge is constructed by the interaction between a thinking subject and the environment in which he lives and grows. It grants a key role to the actions and operations carried out by the subject in structuring his patterns of thought. To build his knowledge, the individual uses prior knowledge as his learning model to calculate and reflect upon his own actions. Prior knowledge plays the role of processor for the new knowledge. In other words, what an individual learns depends largely on what he knows already.

The constructivist theory proposes a universal model (regulation systems specific to living beings) on individual development of intelligence, seen as a form of adaptation. It proposes a single directional model of autonomous intellectual development, i.e. inherent to the subject, and whose evolution is independent of the environment (cultural, educational, etc.) and even more so, teaching.

This approach has been widely reviewed in pedagogical writings and formal instruction. It provides a rationale for *active methods of education* whose pioneers (Claparède, Decroly, and Dewey) stressed the importance of the student's own actions, and education centered on discovery and motivation. In a puerocentric approach, the role of the professor consists of creating a structured and rich environment so that the student discovers for himself the inconsistencies he is ready to confront and replaces them with new intellectual structures.

General principles of constructivism:

a. The student constructs knowledge through his own activity.
b. Intellectual development is an internal and autonomous process not very receptive to external stimuli, particularly teaching.
c. Development is universal and progresses by successive stages.
d. The student can "assimilate" new knowledge only if he possesses a mental structure to receive it. In other words, it is a waste of time to want to teach a student unless he is "ready" to receive the teaching. This belief generated a "wait and see policy" and prompted Vygotsky to agree with Piaget that "instruction follows development".
e. When an individual reaches a certain level of logic, he can reason logically whatever the contents of knowledge.

These various points may well be discussed and called into question on a theoretical level, but such is not the case for formal instruction and teaching doctrines.

From a constructivist perspective, the teacher's role consists essentially in not hindering the process of internal development by not imposing a teaching program (teaching must adapt to the needs of the students). His role is one of observation, diagnosis, and he uses *formative evaluations* and *differentiated instruction*. Current practices in "teacher-mediator" thinking are a mixture of behaviourist theory and constructivist thought. It is advisable in debates to separate the results of scientific research from teaching doctrines and ministerial reforms.

[9] Translated from Enseignement et apprentissage, (URL) http://www.aix-mrs.iufm.fr/services/communication/publications/vocabulaire/n1/roux/index.html

These two theoretical movements essentially favour "the learner": *behaviourism* is centered on the conditions and mechanisms by which a student produces a desired answer under specific conditions; Piaget's constructivism is primarily interested in the modification of the student's internal processes. But both are unaware of the true conditions at school in which teacher, students, knowledge, plus the constraints of implementing and managing a didactic situation are all thrown into the works: epistemological, communication, temporal, social, etc. All things considered, these two theoretical movements that inspired many reforms of the school syllabus and teaching doctrines, do not quite manage to fully account for the relationship between teaching and learning.

Support tool 3.E
Socioconstructivism[10]

Socioconstructivism subscribes to the concepts of *constructivism*[11] but adds an extra dimension, that of social interaction. We shape and create our own knowledge through interactions with others and the environment. Exchanges within the educational environment are seen as essential for the construction of knowledge. *Socioconstructivism* makes it possible to describe more accurately how learning happens in school. It takes place in a school context, through interactions with peers and the teacher.

Socio*constructivism* contains not only a *constructivist* dimension according to which the subject develops a reflexive process on his own knowledge, but also a social dimension, according to which the subject learns with others. Moreover, Jonnaert and Vander Borght (1999) add an interactive dimension (called socio-interactive constructivism) that is highly interesting for teaching. This dimension involves situational learning, using specific content. These situations serve as both the source and the criteria for knowledge. They enable learning by confronting the student to certain requirements and they are the "criteria of knowledge", because this knowledge is relevant only because the student can be efficient in the situation. The three above-mentioned dimensions work together, are interdependent and in continuous dynamic interaction. It is through them that learning occurs. "Learning is a dynamic and adaptive process of construction, reflection, questioning and development of knowledge" (Jonnaert and Vander Borght, 1999: 33)

As regards the organization of academic learning from a *socioconstructivist* approach, the role of teaching is to provide specific situations (creation of meaning) and zones of dialogue and exchange to bring about interactions that allow the student to construct his knowledge. (Jonnaert and Vander Borght, 1999: 30). The value of *socioconstructivism* is to enable us to consider learning as a two-dimensional model: *personal* (cognitive and emotional) and *social.*

---

[10] Raymond, 2001: 10

[11] Believers in social *constructivism* admonish *constructivists* for their "psychologizing". They claim that their sole focus on the study and analysis of the way in which knowledge is constructed within the learner, causes them to fail to see the importance of social interactions and interactions with the environment in the construction of knowledge.

Support tool 3.F

Differences in the three approaches: Cognitivism, constructivism and socioconstructivism

	Cognitivism	*Constructivism*	S*ocioconstructivism*
Nature of the process	Receptive process Individual process of knowledge assimilation* *there is no distinction here between having knowledge and knowing	Creative process Individual process of construction or adaptation of knowledge** **in this instance, knowledge and knowing are distinct	Creative process Individual process of construction or adaptation of knowledge** which is experienced through others and in a given situation.
Teaching-Learning tandem	The primary concern is the reproduction of knowledge.	The primary concern is the construction of knowledge	
Role of the learner	Active receiver of external information which is integrated with the transformation of prior knowledge.	Creator of knowledge through his own activity and control over his prior knowledge.	Creator of knowledge through interaction with others, by manipulating his own knowledge *confronted by the knowledge of others.*
Activity of the learner	Knowledge is assimilated through a succession of activities carried out by the learner to acquire knowledge	The activity relates to prior knowledge as much as it does to new information.	The activity relates as much to prior knowledge as it does to new information *and exchanges with others in specific environments.*
	The activity consists in receiving, selecting and treating external information.	Not a result of external information but rather of work started right away on constructing his knowledge as it interacts with new information.	Not a result of external information but rather of work started right away on constructing his knowledge as it interacts with new information *including exchanges with others.*
Action of knowledge	Knowledge is a system of data processing.	Knowledge is the creation of the learner	
	The knowledge of the learner takes precedence over the knowledge to be learned.	The prior knowledge of the learner is as important as the new knowledge.	Prior knowledge and new knowledge are in interaction with each other and with the knowledge of others through exchanges.
	The learner works initially with information coming from outside.	The learner starts working straightaway with his prior knowledge	The learner starts working straightaway with his prior knowledge which interacts with the knowledge of other learners and the teacher, in situations that are both the source and criteria of knowledge.
Results of the learning process	There is learning when the cognitive structures have been altered.	Learning occurs when knowledge has been adapted and new knowledge has been created.	
Social dimensions	Not generally retained, more or less treated depending on authors.	Not involved straightaway.	Applicable in the processing of new information.

Raymond, D., Cégep Rivière-du-Loup (2000)

Support tool 4.A

Guiding principles for teaching practices[12]

For each statement, indicate on a scale of 1 to 5, the extent to which each one describes the professors' concepts of teaching and learning.

(1: statement does not describe their concept at all, and 5, statement describes their concept perfectly)

Statement of concepts in teaching and learning	Scale 1 to 5
1. The actions of the teacher are designed to exert control over behaviour that is seen as answers provided by the learner. Changes in behaviour are attributable to experience.	
2. Learning is a personal and individual activity of the mind; an active process of construction of reality. Therefore, the learner can only know what he has constructed himself.	
3. The construction of reality depends on the social and physical context in which learning takes place, and on the interactions of the learner with this context.	
4. It is impossible to completely transfer our constructed reality but it is possible to check its level of compatibility with the reality of others. Rather than the truth, it is the viability of the construction which is sought.	
5. Learning occurs when the learner gives an appropriate answer to a specific stimulus.	
6. What is learned or constructed is open to negotiation and is reliant on the meanings which emerge from interaction between the teacher and the student and between the students themselves. The social context plays a major role in validating the interpretations and constructs.	

[12] LAFORTUNE, Louise, DEAUDELIN, Colette, Accompagnement socioconstructiviste, pp. 74-75

7. Learning is influenced by prior understanding which the student brings to the new learning situation. In other words, it is through his prior subjective experiences that the student can give meaning to the new learning.	
8. The focus is on the individual and his learning process. As such, the development of teaching activities should respect and support learning in the learner. Therefore, analysis must be done from beginning to end of the teaching process: for instance: identify the characteristics of the learner and specify the objectives the student will have achieved at the end of the teaching activity (observable behaviour).	
9. The student is in class to receive information provided by the teacher. This information comes from an external and objective reality. The goal of teaching is the transmission of knowledge. However, Skinner (1968) stresses that the student should not passively absorb knowledge of the world in which he lives. He must play an active role. He learns through the use of, experimentation with and involvement in a process of trial and error. It is only when these three conditions are met that we can determine what was learned and identify conditions in which the student learns.	
10. The student plays a proactive role. He is the decision maker in the construction of knowledge. The goals he sets for himself will determine what the learning task will be.	
11. The experts, i.e. those who possess the knowledge, are an important factor in successful teaching.	

Support tool 4.A
Answer sheet

Statements 3 and 6 relate more closely to socioconstructivism. We can choose to specify this fact or not, depending on the level of reflexive thinking of the people we are addressing.

Statement 9 is the one that generally elicits the most controversy, because the first part is seen as behaviourist and the second part as being closer to constructivism even though it is associated with Skinner. We tend to forget that behaviourism has evolved and that within this concept of learning, students must be motivated if they are to play an active role, manipulate knowledge and participate in experiments. This does not imply the belief that students construct and are responsible for their knowledge.

Below is the list of statements. (B) indicates a behaviourist concept, and (C) is a constructivist statement. This information is not to be given to those who are completing the questionnaire.

1: B
2: C
3: C
4: C
5: B
6: C
7: C
8: B
9: B
10: C
11: B

Support tool 4.B

Synthesis of principles and professional actions within the behaviourist and constructivist movements[13]

Behaviourism	2.5 Constructivism
Principles	**Principles**
1. The actions of the teacher are designed to exert control over behaviour (active answers provided by the learner). Changes in behaviour result from experience.	1. Learning is a personal and individual activity of the mind; an active process of construction of reality. Therefore, the learner can only know what he has constructed himself.
2. Learning occurs when the learner gives an appropriate answer to a specific stimulus.	2. The construction of reality depends on the context in which learning takes place (community) and on the interactions of the learner with this context.
3. The focus is on the individual and his learning process. As such, the development of teaching activities respects and supports learning in the learner. Therefore, analysis is done from beginning to end of the teaching process: for instance: identify the characteristics of the learner and state the objectives the student will have achieved at the end of the teaching activity (observable behaviour).	3. What is learned or constructed is open to negotiation and is reliant on the meanings which emerge from interaction between the teacher and the student and between the students themselves. The social context plays a major role in validating interpretations and constructs.
4. The student is in class to receive information provided by the teacher. This information comes from an external and objective reality. The goal of teaching is the transmission of knowledge. However, Skinner (1968) stresses that the student should not passively absorb knowledge of the world in which he lives. He must play an active role. He learns through his use of, experimentation with and involvement in a process of trial and error. It is only when these three conditions are met that we can determine what was learned, the conditions in which it was learned and the results that support and maintain the behaviour learned.	4. Learning is influenced by prior understanding which the student brings to the new learning situation. In other words, it is through his prior subjective experiences that the student can give meaning to the new learning.

[13] LAFORTUNE, Louise, DEAUDELIN, Colette, *Accompagnement socioconstructiviste*, pp. 76-77

5. The experts, i.e. those who possess the knowledge, are an important factor in successful teaching.	5. It is impossible to completely transfer our constructed reality but it is possible to check its level of compatibility with the reality of others. Rather than the truth, it is the viability of the construction which is sought.
	6. The student plays a proactive role. He is the decision maker in the construction of knowledge. The goals he sets for himself will determine what the learning task will be.

Synthesis of principles and professional actions within the behaviourist and constructivist movements (continued)

Behaviourism	2.6 Constructivism
Professional actions	**Professional actions**
1. The teaching approach is sequential and linear.	1. The approach to planning activities provides feedback, is nonlinear and sometimes chaotic.
2. The planning of activities is systematic from beginning to end.	2. The planning of activities is developmental, reflective and collaborative.
3. The objectives guide the development of the process, hence the need for the teacher to recognize and determine the means of evaluation.	3. The objectives emerge during the work process.
4. The knowledge is separated into logical units of learning; the contents and portions of the content are presented sequentially.	4. The teacher uses strategies to support the construction of concepts and to challenge what has meaning for the students, for example cooperative learning, practical activities, active education, guided discovery and projects where the student plans, drives and evaluates his project.
5. The teacher uses teaching methods such as the lecture and repeated practice.	5. There is interaction between the teacher and the student and between the students themselves.
6. The teacher also uses reinforcement.	6. The teacher is not positioned as an expert, but rather as a personal coach in a role of support; he asks open questions and stresses the comprehension of principles more than the memorization of facts and formulas.
7. The evaluation is summative. The preferred evaluations are exams which allow for the collection of data deemed objective.	7. The evaluation is used mainly to provide feedback.

Support tool 5.A

The paradigms of teaching and learning[14]

Indicators	Learning paradigm	Teaching paradigm
Concept of learning	▪ Transformation of information and basic skills into viable and transferable knowledge ▪ Integration of knowledge in cognitive diagrams ▪ Creation of relations	▪ Memorization ▪ Accumulation of knowledge ▪ Linking of all knowledge
Activities in the classroom	▪ Centered on the student ▪ Based on projects, research and problem cases ▪ Interactive relations	▪ Centered on the teacher ▪ High frequency of exercises ▪ Didactic and vertical relations
Methods of evaluation	▪ Relative to the competencies learned ▪ Portfolios	▪ Relative to the knowledge acquired ▪ Tests requiring short answers
Evidence of success	▪ Quality of comprehension ▪ Quality of the learned competencies ▪ Quality of the knowledge constructed ▪ Transferability of the learning	▪ Quantity of information integrated ▪ Occasionally, amount of knowledge acquired
Role of the teacher	▪ Centered on support and eliminating support ▪ Sometimes a learner	▪ An expert ▪ A transmitter of information
Role of the student	▪ A builder ▪ A collaborator ▪ Sometimes an expert	▪ A passive receiver ▪ A learner in the role of interlocutor

[14] Adapted by TARDIF, Jacques, Presentation text for the ministère de l'Éducation du Québec, October 12,1999

Support tool 5.B

Characteristics of the learning paradigm versus the teaching paradigm[15]

Form 1: table to be completed

Indicators	**Learning paradigm**	**Teaching paradigm**
Concept of learning	1. 2. 3.	18. 19. 20.
Activities in the classroom	4. Centered on the student 5. 6.	21. 22. 23.
Methods of evaluation	7. 8.	24. 25.
Evidence of success	9. 10. 11. 12.	26. 27.
Role of the teacher	13. 14.	28. 29.
Role of the student	15. 16. 17. Sometimes an expert	30. 31.

[15] Adapted by TARDIF, Jacques, Presentation text for the ministère de l'Éducation du Québec, October 12, 1999

Support tool 5.C

Form 2: Cardboard cut-outs[16]

No: _____ Transformation of information and basic skills into viable and transferable knowledge	No: _____ 1. Integration of the knowledge in cognitive diagrams	No: _____ Creation of relationships
No: _____ Memorization	No: _____ Accumulation of knowledge	No: _____ Linking of all knowledge
No: ___ **4** ____ Centered on the student	No: _____ Based on projects, research and problem situations	No: _____ Interactive relations
No: _____ Centered on the teacher	No: _____ High frequency of exercises	No: _____ Didactic and vertical relationships
No: _____ Relative to the competencies learned	No: _____ Portfolios	No: _____ Relative to the knowledge acquired

[16] Adapted by TARDIF, Jacques, Presentation text for the ministère de l'Éducation du Québec, October 12,1999

No: _____ Tests requiring short answers	No: _____ Quality of comprehension	No: _____ Quality of the competencies learned
No: _____ Quality of the knowledge constructed	No: _____ Transferability of the learning	No: _____ Quantity of information integrated
No: _____ Occasionally, amount of knowledge acquired	No: _____ Centered on support and elimination of support	No: _____ Sometimes a learner
No: _____ A builder	No: _____ A collaborator	No: _____ Sometimes an expert
No: _____ A passive receiver	No: _____ An expert	No: _____ A transmitter of information
No: _____ A learner in the role of speaker		

Support tool 5.D

Form 3: Answer sheet for table[17]

Indicators	Learning paradigm	Teaching paradigm
Concept of learning	1. Transformation of information and basic skills into viable and transferable knowledge 2. Integration of knowledge in cognitive diagrams 3. Creation of relations	18. Memorization 19. Accumulation of knowledge 20. Linking of all knowledge
Activities in the classroom	4. Centered on the student 5. Based on projects, research and problem cases 6. Interactive relations	21. Centered on the teacher 22. High frequency of exercises 23. Didactic and vertical relations
Methods of evaluation	7. Relative to the competencies learned 8. Portfolios	24. Relative to the knowledge acquired 25. Tests requiring short answers
Evidence of success	9. Quality of comprehension 10. Quality of the learned competencies 11. Quality of the knowledge constructed 12. Transferability of the learning	26. Quantity of information integrated 27. Occasionally, amount of knowledge acquired
Role of the teacher	13. Centered on support and the elimination of support 14. Sometimes a learner	28. An expert 29. A transmitter of information
Role of the student	15. A builder 16. A collaborator 17. Sometimes an expert	30. A passive receiver 31. A learner in the role of speaker

[17] Adapted by TARDIF, Jacques, Presentation text for the ministère de l'Éducation du Québec, October 12, 1999

Support tool 6.A

A concept of learning

How to define learning?

From *the cognitive* viewpoint, ***learning* is**:

> an active, constructive, cumulative process which occurs when the learner actively processes new information, thereby modifying his cognitive structure. (Pôle de l'Est, 1992: 57)

From the *socioconstructivist* viewpoint:

> "*School learning* is a dynamic process by which a learner, through a series of exchanges with his peers and teacher, causes his knowledge to interact for the purpose of constructing new knowledge adapted to the constraints and the resources of the situation he is currently confronted with, in order to use this new knowledge in situations that are not didactic" (Jonnaert and Vander Borght, 1999: 266)

Support tool 6.A (continued)

2.6.1.1.1 A synthesis of the characteristics of learning

Learning is:	
a process …	A process is a series of steps (or stages) organized in time.
… **active**	Learning is carried out thanks to processing or creation by the student who is the lead player in his learning.
… constructive	Learning is built: • through the interaction of new knowledge with the prior knowledge of the student; • through the interaction with his peers and teacher during discussions; • in a situation, within a given context.
… cumulative	Learning is achieved by gradual construction of knowledge in an organized way.
… dynamic	Learning is constructed through the constant interaction with knowledge and exchanges with others. "Learning is not set in stone; the learning process is not over at the end of the courses but continues outside the school" (Jonnaert and Vander Borght, 1999: 223) "Learning proceeds in a social context of communication and interaction characterized, among others, by the diversity of the experiences and the knowledge of the various actors" (Louis, 1999: 23)
And a product	The result of learning is a modification of the cognitive structure (or structure of knowledge) of the person, an adaptation and a new creation of knowledge in the learner.

Support tool 6.B

Teaching principles that guide my practice

Teaching principles which currently guide my practice	General didactic principles of cognitive thought (DISCAS)	I integrate this principle into my practice: (O) often, (S) sometimes and (R) rarely
1.	**1. It is the student who learns**	
2.	**2. The student must have a reason to learn**	
3.	**3. The student acquires knowledge so he may act**	
4.	**4. The student learns by doing**	
5.	**5. The student learns by thinking about what he does**	
6.	**6. The student uses learning strategies**	
7.	**7. The student learns starting from what he already knows**	
8.	**8.**	
9.	**9.**	
10.	**10.**	
11.	**11.**	
12.	**12.**	

Support tool 6.C

2.6.1.1.2 The learner at the heart of teaching[18]

Although the cognitive, constructivist and socioconstructivist approaches do not give us a prescription on how to teach, they do provide us with a perspective on how learning takes place. They help us identify the impact these approaches can have on our current practices and they bring about the emergence of guiding principles to help us choose our teaching style.

The most important implication consists in the fact that neither the teacher nor the contents play a central role in the learning process. Henceforth, the student is at the heart of learning and shares in the responsibility for his learning. The student processes the new knowledge and the teacher creates the conditions that allow this. Moreover, “the sole reference to the program or the textbooks is not enough”. In this approach, traditional ways of using pedagogical objectives are called into question, because the old ways define the contents of learning independently of the learner who has to master the knowledge "(Jonnaert and Vander Borght, 1999: 28). This is no longer a valid model; the new model puts the learner’s knowledge at the very centre of teaching.

Martinet, Raymond and Gauthier (2000) commented on the transformations occurring in the role of teacher subsequent to current reforms in the educational system. They state that: "the new concept of learning, where the student is at the heart of his learning, requires new teaching approaches and new ways of interacting with students. The teacher must adapt his teaching to the progression of individual students; he must focus on the student learner so as to modify the latter’s relationship to the knowledge and thus facilitate its acquisition". (Raymond and Gauthier, 2000: 30[19])

From a relationship with a world considered to be objectively true, we now enter a worldview subject to interpretation and debate. Indeed, the "prior knowledge of the learner, that which is already in long-term memory, determines not only what can be learned but also what he will be able to learn effectively and how it will be learned.” (Tardif, 1992: 32) In this context, no teacher can ignore the prior knowledge of students and the learning models that result from it, nor can he neglect to act upon it without running the risk of impeding the exploration of the new knowledge to be taught. By overlooking the student’s prior knowledge in his teaching, the learning model in memory remains intact and significantly hinders the student’s ability to comprehend the new knowledge he is to build. To enable the construction of new knowledge, the teacher must take prior knowledge into account.

.

The major effect of the new education paradigm is openness: "*it validates the introduction of pedagogy and didactics that base the exploration of knowledge on the construction of learning by the students themselves*". (Morf, 1994). Consequently, it is important to place the student at the heart of learning and not to take away his responsibility for his own learning. It is the student, after all, who is venturing out to discover the world, his world. And his discovery is facilitated by the teacher’s intervention.

---

18 Raymond, 2001:33-39

19 Martinet, M.-A., Raymond, D. et Gauthier, C. (2000). *La formation à l’enseignement. Les orientations. Les compétences professionnelles.* . Québec : Ministère de l’éducation, Direction de la formation et de la titularisation du personnel scolaire. Provisional version for consultation

4.2 Some teaching consequences

Svinicki (1991) identifies six principles resulting from **cognitive theory** and their consequences for teaching.

Principles resulting from cognitive theory	Consequences for teaching
1. If information must be learned, it must be recognized as important by the learner.	*The more effectively attention is directed at what must be learned, for example key concepts and essential ideas, the greater the probability of achieving in-depth learning.*
2. The student processes the data during learning so that it becomes meaningful to him.	*The teacher as well as the student should use examples, images, details and, relationships connected to the prior knowledge of the students to make information more meaningful.*
3. The students store information in long-term memory according to structures they have created through their prior understanding of the world.	*The teacher can facilitate the organization of this new information by providing a structure or organization of the information and more particularly, by providing a structuring the students already know or requesting they build such structures or organizations.*
4. Students who are learning evaluate their learning constantly so they may refine and revise the knowledge.	*Opportunities given to the student to verify and evaluate his acquired knowledge are considered support tools in his learning process.*
5. The transfer of learning to a new context is not automatic; it results from the diversity of applications the student is subjected to.	*Opportunities must be given at the time of the initial learning so that students may carry out future transfers.*
6. The learning is facilitated when the students are conscious of their learning strategies and that they are in control of the situation.	*The teacher must help students learn how to translate these strategies into action when they are needed.*

The following table shows examples of teaching practices coherent with **a constructivist perspective** on learning.

Some teaching practices pursuant to a constructivist perspective
▪ To bring students to verbalize their thoughts and concepts so as to build a model of

Some teaching practices pursuant to a constructivist perspective

their comprehension and grasp the meaning behind their concepts and work habits;

- To identify teaching activities that bring students to verbalize and confront their ideas with those of the teacher and those of other students;
- To identify teaching activities that lead to the discovery of deficiencies and inconsistencies;
- To alter our attitude towards student errors which are not random and not caused by "erroneous concepts". They arise logically from concepts the students have constructed previously;
- To use teaching situations that are most effective in helping students construct adequate learning models while facilitating discussions on conceptions;
- To identify and validate students' viewpoints and their way of doing things;
- To structure courses based on important ideas, complex problems and global situations rather than giving the students information or knowledge in piecemeal fashion;
- To reduce lectures and presentations and grant more time for collaborative and cooperative activities;
- To help the student to develop his capacity for conjecture and his ability to make assumptions, explore them, discuss them and test them;
- To evaluate learning in an authentic way; to assess the process as well as the product.

Support tool 7.A

Methods of teaching: a guide to self-reflection[20]

- For each of the teaching methods or formulas below, indicate their frequency of use. Do you use them rarely, occasionally or regularly?
- Why are some methods used regularly and others rarely? Can you associate certain methods with certain subject matters or certain contexts?
  (Use the letter **P** to indicate personal use, and **C** for use by colleagues)

Methods	Rarely	Occasionally	Regularly	Personal comments
1. Team work				
2. Cooperative learning				
3. Presentation of contents (lecture)				
4. Individual exercises				
5. Role play				
6. Games and simulations				
7. Research				
8. Tutoring				
9. Individual work				
10. Workshops				
11. Presentation by students				
12. Demonstration of a procedure, of an algorithm				
13. Practical activities				
14. Learning through projects				
15. Problem cases				

[20] Adapted by Lafortune, 2001: 95

Support tool 7.B
A signature for a teaching style[21]

1. Indicate your response to each of the statements below by putting a checkmark in the *mostly true* column or the *mostly false* column.
2. Look for someone in the group who answered differently and ask for that person's signature.
3. The idea is to collect the greatest number of signatures and the greatest number of different signatures.

Style of teaching	Mostly true	Mostly false	Signatures
1. Have students work in teams.			
2. Make changes to course planning based on student questions on upcoming weekly content.			
3. Initiate exchanges so students may discuss their errors/mistakes.			
4. Introduce new theoretical content via practical activities for students.			
5. Present the disciplinarian content of the course through lectures.			
6. Generally propose one procedure for students to follow.			
7. Before beginning a new subject matter, bring students to talk about what they already know about it.			
8. Before presenting the students with an evaluation, ask them to do a self-evaluation.			
9. Provide students with examples before asking them to solve problems or do exercises.			
10. Elicit discussion/exchanges among students on their ways of proceeding.			

[21] Adapted by Lafortune, 2001: 97

Style of teaching	Mostly true	Mostly false	Signatures
11. Help students identify their learning process rather than help them find the right answer.			
12. Provide the answer when students are asked a question and no one answers.			
13. Value the fact that students succeed in covering the entire program contents.			
14. Prepare the students adequately for the future summative evaluation.			
15. Keep tabs on student motivation.			
16. Introduce students to strategies so they may create others.			
17. Ask students to discuss their thinking/reasoning with others.			
18. Teach students how to criticize the approach of other students.			

Support tool 7.C

Methods and their connection to the socioconstructivist model[22]

- How do these methods reflect a socioconstructivist perspective?
- In the "Socioconstructivist Perspective Column" (**SPC**), indicate the extent to which the strategies below correspond to this perspective: (**1)** meaning "does not generally correspond" and (**5)** meaning "generally corresponds".

Methods	**Socioconstructivist perspective**	
	SPC	**Why?**
1. Teamwork	**4**	These activities encourage interaction between students. However, it is their structure that will determine if they fall under the socioconstructivist model. The tasks and support tools suggested should favour the construction of knowledge, the connection to prior knowledge, etc.
2. Cooperative learning	**4**	
3. Presentation of contents (lecture)	**1**	Although this type of activity is not excluded from the socioconstructivist model, it should not characterize the teaching approach. It can be used, for example, within the framework of a project if the students need help to overcome a difficulty, master a technique or essential skill needed to pursue his project (i.e., mastery of algorithms for calculation).
4. Individual exercises	**1**	
5. Demonstration of a procedure, of an algorithm	**1**	
6. Role play	**3**	Games and role play present an interesting option insofar as they prove to be stimulating for the students. In terms of approach, it is difficult to establish a link between these methods and the socioconstructivist perspective. However, they can be a good way to develop certain competencies in a more structured environment (communication skills and cooperation, for example).
7. Games	**3**	
8. Individual work	**2**	To evaluate individual work, it is necessary to know its context. Regarded as an essential stage in research done by a student, it fits very well in a socioconstructivist way of thinking. However, when considered as an activity that occupies most of the student's day during school hours, this would not be favoured by a socioconstructivist approach.

[22] Adapted by Lafortune, 2001: 99

9. Research	**5**	These methods are coherent in varying degrees with a socioconstructivist perspective: students are in interaction and usually work collectively on projects. Interventions should awaken sociocognitive conflicts (tutoring, presentations done by students), and facilitate the structuring of knowledge during workshops, research or learning projects.
10. Tutoring	**3**	
11. Workshops	**4**	
12. Presentations done by students	**4**	
13. Practical activities (concrete situations)	**3**	
14. Learning project	**5**	
15. Problem cases	**5**	

Support tool 8.A

What are the essential characteristics of a competency as a learning objective?

2.7 **Definition**	**Characteristics**
"A competency is a set of socioaffective behaviours, cognitive and psycho-sensory-motor skills that make it possible to function and perform an activity or a task with a degree of performance that corresponds to the minimal requirements of the labour market"	
"A competency is defined as the ability to fill the roles and complete the tasks required by work function"	
"A competency includes an integrated set of cognitive, socioaffective and psychomotor skills"	
"An acquired skill due to the assimilation of relevant knowledge and experience, which allows us to delineate and resolve specific problems"	
"Know–how that allows for immediate application thanks to a repertory of potential actions"	
"Sum of knowledge, know-how and personal conduct which make it possible to play an appropriate and effective role, perform a function or accomplish an activity"	
"Reliable capacity to act immediately and effectively in a given field, based on the integrated and relevant sum of knowledge, skills, attitudes and values"	

Support tool 8.B

What is your definition of competency? Similarities and differences with other proposed definitions

2.8 DEFINITIONS OF COMPETENCY

Personal definition:

Personal notes taken during general discussion:

Support tool 8.C

Characteristics of a competency according to Pôle de l'Est

A competency is:	
• *A learning objective*	In a schooling context, it constitutes the final reference of a given training (goal to reach), taking its meaning from the work function targeted or the capacity to pursue a higher education in a given field; it is therefore an entry threshold in both fields as well.
• *centered on the development of the student's capacities,*	A competency is acquired through practice. It requires time and frequent applications done by the student himself.
• *to act in an autonomous way,*	Competency presupposes that the person knows how to identify and access the resources they need to pursue their own progress.
• *to identify and resolve*	Competency requires the visualization of a problem or a specific situation so that the student can select a process and identify a strategy which will make it possible to achieve the desired solution.
• *effectively*	The application of the competency by the student must be effective and produce the desired results, in conformity with the standards.
• *problem situations of a specific type*	Competency is always contextualized; it is always part of a given context of activity.
• *on the basis of conceptual and procedural knowledge that is integrated and relevant.*	It is a structured whole that integrates the many types of knowledge that make up the competency; and each parcel of knowledge can be mobilized whenever needed, i.e., at the opportune time. This knowledge is relevant because it will have been selected on the basis of its value in relation to dealing with real life situations.

Translated from: RAYMOND, Danielle, 2001 *Apprendre oui mais… qu'est-ce qu'apprendre?* Synthesis for MIPEC, March, Université de Sherbrooke, p.30.

Support tool 8.D

Principles[23] pursuant to the nature of competencies and their impact on my teaching

Principles	What this really means to me	How I use it in my teaching
Global: elements analyzed from a global perspective		
Construction: activation of prior acquisitions, elaboration of new learning and organization of the information		
Rotation: from global to specific and back to global		
Application: to learn by doing		
Distinction: between contents and process		
Meaningfulness: cases that are meaningful and stimulating for the student		
Coherence: coherent relation between teaching activities, learning activities, evaluation activities and the competency		

[23] Principles taken from: LASNIER, Francois, Réussir la formation par compétences, Guerin, 2000 p. 159

Principles	What this really means to me	How I use it in my teaching
Integration: the components presented are connected to each other and to the competency. The learner develops the competency by using the components in an integrated way.		
Iteration: the learner is subjected several times to the same type of integrating tasks relative to the competency and the same disciplinarian content.		
Transfer: transfer from a source task to a target task. The use of knowledge and capacities in a context different from the original context in which they were acquired.		

Support tool 9.A

A problem situation, what and why

By André Chabot, educational adviser
http://www.cegep-chicoutimi.qc.ca/reflets/refletsv10n1/reflet03.htm#retour

Various experiences in teaching show us that a pedagogical approach based on problem situations can contribute to learning integration if it includes the core concepts and disciplinarian methods found in the course. Teaching based on problem situations provides an excellent framework from which to do a global assessment and verify the integration of course components. This approach makes it possible to measure students' ability to implement behaviours to effectively solve complex problem situations presented in the program. Problem situations are not limited to mathematical and scientific fields. Any task that contains initial data, a final goal as well as constraints, and for which an individual does not have an answer, constitutes a problem to be solved.[24]

A problem situation can be dismantled, remade and enriched to become a new context and possibly a new problem. The progression of learning in a course could be structured using the final problem situation as a challenge for the student at the end of the course. It is one of the first stages in planning activities. This support tool makes it easier to build progressive learning (sections of the course) by dividing the course into learning sequences which take into account the contents of the competency.

The use of real problem situations combined with appropriate strategies can improve self-confidence, motivation, communication and teamwork. It also contributes to more thorough syntheses and analyses. The problems can be dealt with in teams, which requires the communication of ideas and cooperation within small groups, thereby improving overall effectiveness and appreciation for teamwork. The learner is encouraged to express his thoughts, to interact and help the discussion move forward.. In certain cases, the student can involve himself from the beginning in defining the problem, distinguishing what is essential from what is secondary, summarizing the information or identifying relevant data.

The student profits from the variety of circumstances surrounding the problem(s); he learns to recognize and resolve them; this is the reason why problem situations occupy the central role in an integrated learning pedagogy, in approaches based on competencies or not. To sum up, a problem situation provides the student with a concrete learning model for the use of a competency, through its components, content, context of achievement and requirements. It gives meaning to the learning process and supports student motivation.

[24] Pôle de l'Est, 1996

Here are two examples created by colleagues at the college: one in philosophy and the other in office automation. **Final problem situation of the course:**

Ethics and policy (340-BSB-03)

<table>
<tr><td>Final objective
To give an opinion on the ethical and political problems of contemporary society.</td><td>Cognitive skills
• Critical thought
• Integration</td></tr>
<tr><td>Concepts to be used
The ethical and political dimension of the situation.
Philosophical, political and ethical theories.</td><td rowspan="2">Description of the situation
You are a political negotiator attached to the government. At forty years of age, the time has come for you to be given a seat on the Decision-making committee. The problem you are faced with is the economic disparity between poor and rich countries. You must consider the structure of a society where equality and justice exist on all continents. But an obstacle is placed in front of you: The presence of the most famous heretic the world has ever known: The Martyr.
You are dedicated to defending the philosophical position. But you will have to answer the fundamental ethical question: Why must we be fair?</td></tr>
<tr><td>Procedure to follow
• The philosophical essay</td></tr>
<tr><td>Difficulties of the problem situation
• To conceptualize
• To problematize
• To argue</td><td>Task
Your investigation will lead you to explore the personal, social and political aspects of this problem. You will prepare for your confrontation by using various philosophical theories, both moral and political. You will have to conceptualize and problematize the situation. However, you will have had thorough training through the use of simulations, discussions and research. Do not be frightened by the challenge that awaits you.</td></tr>
<tr><td>Usual clues allowing for problem recognition
• Recognition of the world politico-economic context
• Philosophical analysis of the concepts of justice, equality and utopia</td><td>Expected duration
3 hours</td></tr>
</table>

Final problem situation of the course:
data processing: basic concepts

<table>
<tr><td>Final objective
To do word processing using basic software concepts</td><td>Cognitive capacities
• Memorization
• Organization
• Observation</td><td>Attitudes and values*
• Concern for the quality of the written language
• Concern for the quality of the presentation
• Concern relative to the security of the data
• Sense of responsibility
• Ability to adapt
• Autonomy*</td></tr>
<tr><td>Concepts to be used
• Terminology
• Computer
• Basic functions of word processing software menus:
• File, edit, post, format, insertion tools, tables, window, help</td><td colspan="2">Description of the situation
It is 10:00 a.m. when a work colleague drops by your office; he is completely discouraged. He spent hours processing a text, using word processing software, but did not copy it on diskette, which only contains the original document (rough draft). Fortunately, he did print a copy of the work before shutting down the computer.
He must present this document for approval at the beginning of the afternoon and then make the necessary corrections so the final copy can be given to a superior by end of the day. He will not have the time to redo the work if he wishes to respect the deadlines.
Given that you are at ease with the basic concepts of this software, you offer to process the original text with respect to the printed copy (model) and to copy it on diskette.</td></tr>
<tr><td>Procedure to follow
• Use the basic menu functions</td><td colspan="2" rowspan="2">Task
You must, using the basic functions of the software, process the copy so as to make it identical to the printed copy that your colleague gave you.</td></tr>
<tr><td>Difficulties of the problem situation
• To choose the appropriate commands
• To identify changes in a text</td></tr>
<tr><td>Usual clues allowing for problem recognition
• Rough original text
• Model</td><td colspan="2">Expected duration
1 hour and 40 minutes
During exam week at the end of the session</td></tr>
</table>

Support tool 9.B

Problem situations : French at secondary level

Problem situations[25]

| Qu'est ce que c'est ? | Caractéristiques | Avantages | Selon Meirieu | Selon Astolfi |

What is a problem situation?

- The problem situation is a learning opportunity.
- It is a means of learning, not the result.
- It is a teaching strategy that supports the active participation of the students.
- It allows for the construction of knowledge.
- The problem situation is a task that is:
  - global,
  - complex,
  - meaningful.

The problem situation is a global task:

1. It is complete, i.e. it has a context (initial information) and a goal;
2. It requires more than one action, more than one procedure and more than one operation for resolution;
3. It can be broken up into several parts or elements.

The problem situation is a complex task:

4. It calls upon several types of knowledge (declarative, procedural and conditional);
5. It creates a cognitive conflict, the solution is not obvious;
6. It is a challenge the students can meet (realistic and achievable);

[25] Translated from : **http://www.cslaval.qc.ca/tic/francais/grel/sitprobl.htm**

7. It can impact several objectives of the program; it is thus very structured on a didactic level because it is created as a function of some precise learning.

The problem situation is a meaningful task:

8. It is meaningful for the student because it is something he knows, something that can connect to his reality;
9. It is concrete because it has a goal (a product), calls for concrete action and requires the use of knowledge, techniques, a strategy or algorithm.

Characteristics of a problem situation:

1. It contains initial data which determines the context and is needed to solve the problem.
2. There is a goal to reach (different from the teaching objective) which mobilizes and organizes the knowledge.
3. There are constraints or obstacles to be surmounted which require a reorganization of prior knowledge and a discovery of alternate means, which in turn leads to learning.
4. The approach and the solution are not obvious; the person must undertake an active cognitive search on how to proceed.

Advantages of the problem situation:

1. It makes it possible for the students to achieve real learning by placing them at the heart of the learning process.
2. It demands the active engagement of the students, who become more active players, using their cognitive capacities, their intelligence.

The problem situation according to Meirieu:
"A subject carrying out a task is confronted with an obstacle"

- The subject is focused on the task, the educator on the obstacle.
- Overcoming the obstacle must signify a stage in the cognitive development of the subject.
- The obstacle is overcome if the tools provided and the instructions bring about the necessary cognitive operations.
- To carry out the same mental operation, individuals may use very different strategies.
- The conception and implementation of a problem situation must be controlled by a series of evaluation tools.

It is not a case of "teaching the right answers" but rather a situation of "problem based learning".

Preliminary questions to answer before elaborating a problem situation:

1. What is my objective? What do I want to make the learner acquire, which for him will be an important stage in his progression?

2. What task can I propose that requires access to a specific objective (communication, reconstitution, and conundrum, remedial, resolution) in order to be successful?
3. What plan of action must I implement so that the mental activity of carrying out the task allows the objective to be achieved?

    - Which materials, documents and support tools should I make available?
    - Which instruction should be given so that learners use the materials to achieve the task?
    - What constraints are necessary to prevent the learning from being circumvented?
4. Which activities can I introduce to vary the tools based on the various strategies? How can I vary the support tools, approaches, levels of guidance, grouping methods?

(Philippe Meirieu, methodological guide on the elaboration of a problem situation)

Support tool 9.C
Characteristics of a problem situation[26]

Competency is the knowledge to act, an effective potentiality of action which is realized in a concrete situation. The following table summarizes this knowledge to act.

COMPETENCY = KNOWLEDGE TO ACT

Competency	=	knowledge to act responsible and validated	=	To know how to mobilize knowledge To know how to integrate knowledge To know how to transfer knowledge	Resources (knowledge, abilities…)

In a professional context

LE BOTERF (1995) P.33

This knowledge to act develops gradually through the resolution of problems. We learn to solve a problem by processing it and being confronted with the difficulties of finding solutions. Competency allows for an understanding of the world that includes an enriched perception (this is the nature of the case) and an increased intervention potential (this particular case requires this type of action that I will implement).

Competency is implemented relative to the set of circumstances perceived as the problem to solve. During the course of his education, a student will be confronted with the various ways in which these circumstances appear so that he learns how to recognize them and is able to work towards solving them. This explains the central role given to problem situations in education based on developing competencies.

[26] PÔLE de l'Est, 1996: 264-269

The progress of learning based on problem situations does not offer the same reassurance as traditional approaches. Perrenoud (1996c) summarizes this idea in the following manner: "To practice transfers is to become accustomed to innovation, to letting go of safe traditional exercises and replacing them with **problem situations** with which each individual is unfamiliar, because the problem still remains to be identified and structured and, even then, solutions are not obvious (…)

Is transfer learned? At least three things appear to be learned in conjunction with transfers.

a. We learn to deal with our anxiety and initial discouragement through experiences which show that we know more than we thought we did; but it takes time and effort to link our existing knowledge relative to the situation at hand.

b. We learn general strategies of problem solving "on the job", but also through the explicit teaching, on a metacognitive level, of general problem-solving strategies and in particular the following problem: what to do when I don't know what to do? How to mobilize resources to solve the problem while acknowledging that no solution comes to mind?

c. We broaden our knowledge, competencies and conceptual models through the use of mechanisms that Piaget called differentiation, coordination and generalization so that cognitive capacities of a higher order become stabilized.

We suggest the following definition of a problem situation:

> *A problem situation* is a concrete situation describing both the most realistic context and the task that confronts the student so that he may implement the conceptual and procedural knowledge necessary for the development and demonstration of his competency.

Characteristics of a good problem situation

2.9

1. It is typical of the family of situations that defines the sphere of action of the competency.

2. It presents the student with a real problem, insofar as the solution is not obvious and cannot be solved with an algorithm.

3. It is based on the cognitive level of the student (within the zone of proximal development of the student's mental acquisitions).

4. It introduces a task that the student perceives as an interesting challenge.

5. It offers an opportunity for the student to enrich his experience.

6. It is similar to a real situation i.e. a situation the student is likely to encounter outside the school, within the framework of his professional or private life.

7. It calls on the knowledge and know-how that make up a competency.

8. It uses a language that is clear and understood by the student.

The table on the next page provides additional relevant instructions[27].

[27] See Astolfi (1993); this article, adapted by Meirieu (1990), presents the three functions of a problem (criterion, goal or means of learning), the characteristics of problem-situation based education as well as the three types of relations between a student and a problem situation (logic for action, logic for success and logic for learning).

2.9.1.1 Characteristics of a problem situation

1. A problem situation is centered on the **overcoming of an obstacle** by the class, using an obstacle that has been **well-identified** beforehand.
2. The study is organized around a **concrete situation**, which makes it possible for the student to make **assumptions and to conjecture.** It is not a *purified* study, nor an *ad hoc* illustrative example that we find in traditional teaching (which includes practical exercises).
3. The students treat the situation as **a true enigma to be resolved**, in which they must involve themselves. This is a precondition for **devolution** whereby the problem, although initially proposed by the professor, becomes "theirs".
4. Initially, the students **do not possess the means to a solution** since they must first be confronted by the obstacle. The need to resolve the problem is what leads the student to work out or collectively appropriate the intellectual tools that will be necessary for the construction of a solution.
5. The situation must offer **some resistance** so the student will bring his prior knowledge and **learning models** into question and, in so doing, construct new ideas.
6. The solution should not be perceived as out of reach by the students, since the problem situation is not a problematical situation in itself. The activity must be used within the **zone of proximal development** which favours the stimulation of **intellectual challenges** and the **internalization** of the "rules of the game".
7. **The anticipation** of results and its collective expression precede the search for a solution, with the "**risk"** taken by each individual being part of the "game".
8. The work relating to the problem situation is carried out like a **scientific debate inside the classroom**, stimulating potential **sociocognitive conflicts.**
9. **The validation** of the solution and **its ratification** are not provided by an external source, such as the professor, but result rather from the **way the situation itself is structured**.
10. The collective re-evaluation of the path taken is an ideal opportunity for a **reflexive review** that is metacognitive in nature and helps the students become conscious of **the strategies** they used heuristically, and provides them with **procedures** that can be used in other problem situations.

Astolfi (1993)

Examples of problem situations are provided in the following pages.

2.10 Problem situation in humanities

Final objective

To analyze a current problem starting from several approaches in humanities

Cognitive skills

To detect a problem, to structure it

Concepts

- Conflicts
- Power
- Cooperation
- Sovereignty

Procedures

- Argument
- Politico-socio-economic analysis
- To collect information
- To communicate

Description of the situation

The Black Hills of Dakota (Educational Leadership, March 1994)

There is a current on-going debate about the Black Hills (mountains) of south Dakota. Should ownership be given back to the Dakota, Native Americans who lived there before the Americans drove them out?

Several parties are involved and discussions are often impassioned. How to disentangle and clarify this public debate?

Difficulties

- Objective vision
- Several disciplines
- Use of concepts specific to the humanities

Usual clues

- Treaties
- Journals

Tasks

As a specialist in humanities, you are asked to analyze this problem and present your analysis to a knowledgeable public.

The organizing committee of this public debate wishes to obtain a copy of the texts and documents which you will use at the time of the public presentation.

You will find attached ten texts on the subject.

2.11 Problem situation in psychology

Final objective

To analyze a communication problem using a psychological approach

Cognitive skills

To detect a problem, to interpret it

Concepts

- Principles of communication
- Self-image
- Needs
- Emotions
- Relational skills
- Conflicts

Procedures

- Description of the problem
- Psychological interpretation
- Analysis
- Written presentation

Description of the situation

You have been a trainee in Human Resources in a medium-size business for 6 months. The company is managed by a man who invested energy and determination to build an organization he directs it as would a father concerned about the wellbeing of his employees and the success of his enterprise.

Richard is an employee of this medium-size business. In his later forties, he is in charge of maintenance. An alcoholic in denial, he is divorced, has been rejected by his only daughter, is considered an introvert and feels unloved. His interpersonal contact with other employees, particularly females, can be viewed as aggressive and you are shocked by what you observe.

Excessive tension has taken hold of the team and performance decreases. Recently, you became the earpiece for employees who do not dare complain directly to the boss. Completely caught up in his work, the boss appears accepting of Richard, who is very hard-working.

Difficulties

- Objective vision
- Several concepts

Tasks

Thanks to your qualities of insight and objectivity, you are asked to provide an analysis of the situation for the Director who will then bring it to the Board of directors.

The analysis will have to include the concepts presented, a description of the problem, your interpretation based on psychological principles and suggestions for resolving the situation.

Usual clues

Expected duration

Text of approximately 750 words (3 pages) written in the classroom during the three last hours of the course.

Support tool 9.D

2.12 Learning by problem situation

Final objective

To propose new learning strategies particularly learning by problem situation

Cognitive skills

To organize, elaborate, integrate

Key concepts

- Concept of learning
- Academic success
- Learning strategies
- Pedagogical formulas
- Teaching approaches
- Problem situation
- Personal teaching concepts

Procedures to follow

- Stages of problem-based learning
- Details of a problem situation
- Oral presentation of a report

Potential difficulties

- Procedure for elaborating a problem situation
- Personal experience of such a learning strategy

Documentation available:

Support tool 9.B

Support tool 9.C

Support tool 9.D

Expected duration

Three hours

Description of the situation

"Over a 2-year period, the rate of success has dropped by 7% in your program of studies. Following an analysis by the program team, several assumptions were retained to resolve the situation. One assumption is the need to invest more in new teaching approaches that support increased learning.

As a member of the special committee elected by the program team, you are charged with recommending new learning strategies, particularly problem based learning and you must also convince your colleagues of the benefits of these teaching approaches."

Tasks

1. Presentation of the topic: understanding the mandate, evaluation of what is at stake.
2. Personal reflection: individual work, write down in a few words:
   - what I know of the learning strategies proposed in the mandate
   - my recommendations for the study of problem-based learning
   - my initial arguments to convince my colleagues of the value of this teaching approach.
3. Division of the group into teams of 4 or 5 people.
4. Drafting of common proposals:
   - 4.1 Description of a problem situation and examples (Support tool 9.A)
   - 4.2 Appropriation of the instructions to work out a problem situation (Support tool 9.B)
   - 4.3 Study of the characteristics and advantages of using this learning strategy (Support tool 9.C)
   - 4.4 Study of the problem situation used in the current activity (Support tool 9.D)
   - 4.5 Drafting of common proposals to convince colleagues of the teaching benefits of this approach
5. Pooling:
   - 5.1 Each group documents their proposals and justifies them
   - 5.2 Compilation of the group presentations
6. Synthesis: group discussion based on synthesis of team presentations

Support tool 10.A

<table>
<tr><th colspan="2">2.13 Problem situation: to write a lesson plan</th></tr>
<tr><td>Final objective
To write a lesson plan by applying a typical learning process</td><td>Cognitive skills
To organize, elaborate, integrate</td></tr>
<tr><td>Key concepts
▪ Conception of learning
▪ Cognitivism
▪ Traditional teaching
▪ Cognitive principles
▪ Lesson Plan
▪ Problem situation
▪ Typical learning process
▪ Learning activities</td><td rowspan="2">Description of the situation
"Within the scope of a developmental activity based on a cognitive learning concept, you are introduced to a typical learning process. During a departmental meeting to plan for developmental activities, it is decided to experiment with a plan of activities based on these principles.
Your team is selected to draft a lesson plan proposal using a typical learning process.
In order to appeal to everyone, a theme that applies to all courses is selected: "techniques for note-taking".
You are expected to present the results of your teaching plan at the next departmental meeting."</td></tr>
<tr><td>Procedures to follow
▪ To plan teaching activities
▪ To put learning activities in a sequential order
▪ To apply a typical learning process
▪ To decide on learning strategies
▪ Techniques for note-taking</td></tr>
<tr><td>Potential difficulties
▪ Cognitive principles
▪ Typical learning process</td><td>Tasks
1. Study the problem situation: support tool 10.A
2. Use the form (Support tool 10.B) to draft your lesson plan.
3. Make use of available documentation
4. Present the report to the group</td></tr>
<tr><td>Documentation available:
Support tool 10.C: Typical learning process and Sequence of interventions associated with a typical learning process from a cognitive perspective</td><td>Expected duration
Three hours.</td></tr>
</table>

Support tool 10.B

Form for lesson planning

<table>
<tr><th colspan="2">2.14 Lesson plan on note-taking techniques</th></tr>
<tr><td>Final objective of the lesson:
Master note-taking</td><td>Cognitive skills:

Learning techniques:</td></tr>
<tr><td>Key concepts
▪
▪
▪
▪
▪</td><td rowspan="2">Learning activities based on a typical learning process
1. Activation:
_____
_____
_____
2. Elaboration:
_____
_____
_____
3. Organization:
_____
_____
_____
4. Application:
_____
_____
_____
5. Proceduralization:
_____
_____
_____
6. Integration:
_____
_____
_____</td></tr>
<tr><td>Procedures for note-taking based on the context:
▪
▪
▪
▪
▪
▪</td></tr>
<tr><td>Potential difficulties
▪
▪
▪</td><td>Task:
Plan for learning activities at each stage of the typical learning process to enable mastery of note-taking in a variety of contexts.</td></tr>
<tr><td>Teaching material needed</td><td>Evaluation of the learning:</td></tr>
</table>

Support tool 10.C
Typical learning process[28]

Typical learning process	
Activation	Awakening of the cognitive and emotional knowledge of the student based on the competency or knowledge to be developed.
Elaboration:	Establishment of connections by the student, rightly or wrongly, between what he knows and what he learns or seeks to understand as a phenomenon.
Organization	Clear and accurate structuring of knowledge by the student.
Application	Use of conceptual or declarative, procedural and conditional knowledge that was acquired in the organization stage, with a decreasing need for help and support.
Proceduralization	Use of structured acquisitions in increasingly complex situations so as to develop the ability to act quickly while being effective. This stage aims at making increasingly automatic the implementation of problem solving steps.
Integration	Use of the acquisitions connected to the development of a competency in an increasingly autonomous manner. The final goal of this process is the integration of new learning to the student's knowledge structure and his way of approaching situations using this new structure.

(Pôle de l'Est 1996: 119-121)

When he learns, the student sets in motion a series of cognitive operations, as seen in a "typical learning process".

Therefore, for a student to learn, he must remember what he knows about the subject (**activation of prior knowledge**) and formulate assumptions to describe the phenomena based on his prior knowledge (**elaboration**). These first two stages are insufficient; the student must also be put in contact with the new knowledge so as to endorse it and organize, with assistance, information in the form of a cognitive network, establishing relevant links between each bit of knowledge (**organization**). If these relationships are poorly established by the student, it will remain surface learning. The student must then apply this knowledge structure to simple situations (**application**) before applying it "automatically" to increasingly complex contextualized situations (**proceduralization**), by establishing connections between increasingly rich knowledge (**integration**).

Sequence of interventions associated with a typical learning process

[28] Raymond, R., Qu'est-ce qu'enseigner, 2001: 29-33

from the cognitivist viewpoint

Typical learning process	*Suitable teaching interventions*
Activation	To stimulate student motivation by highlighting the connection to the competency development, the relevance of the knowledge to be acquired, the relevance of the task suggested and its feasibility: ◗ Exchanges/discussions with students ◗ Highlight a stimulating application ◗ Highlight the student's capacity to succeed To carry out a task related to the competency based on the previously acquired knowledge of the student or, if the prior knowledge is not sufficient, a task relating to a known subject that can be used as an analogy for the competency or the knowledge to be learned: ◗ Choice of simple situations ◗ Individual or team questioning ◗ Pooling ◗ Request for simple examples from the student ◗ Requests for recall by the student of knowledge acquired in prior courses, with or without the help of documentation
Elaboration	To require that the student validate his assumptions of the situation, phenomena or knowledge to be processed, and to require valid documentation to justify the assumption. ◗ "Brainstorming" ◗ Explanation of problem situations, requests for explanations of unusual laws or phenomena ◗ Precise justification for assumptions made ◗ Requests for explanations of contradictory phenomena or divergent viewpoints among the students ◗ Confrontation of student explanations by the teacher

Sequence of interventions associated with a typical learning process from a cognitivist viewpoint (continued)

Typical learning process	*Suitable teaching interventions*
Organization	To initially present the concepts and procedures to the students: ◗ Use of structures: diagrams, tables, procedural lists, etc. To follow up with means by which the student can continue on his own: ◗ Schematization of concepts, procedures ◗ Modeling of a situation ◗ Drafting of a summary sentence ◗ Production of a summary ◗ Description of relationship between key words and concepts ◗ Use of examples explicitly illustrating the concepts being studied
Application	To introduce simple situations initially, with appropriate support for each student: ◗ Highlighting of the process used ◗ Demonstration by the teacher ◗ Request for application using support tools Justification based on relevant concepts and procedures, for the choices and applications by the student: ◗ Research of examples and non-examples by the student ◗ Exercises, problem solving with feedback ◗ Explicit interpretation of problem situations resolved by others
Proceduralization	To confront the student with increasingly complex cases: ◗ Progressive contextualization of the problem situations ◗ Situation scenarios, role play, increasingly complex labs, case studies To gradually reduce support (assistance, documentation, approaches) as well as time allotted for the task: ◗ Request for students to produce explicit written formulations of the stages in the procedure ◗ Search for personal examples ◗ Self-evaluation

Sequence of interventions associated with a typical learning process from a cognitivist viewpoint (continued)

Typical learning process	*Suitable teaching interventions*
Integration	To introduce the student to a new situation, in a context where he is not told in advance that he will have to apply such or such procedure, and have him do the following: ◗ Identify the nature of the process ◗ Model the situation correctly ◗ Solve the problem situation ◗ Justify his choice To support the transfer of acquired knowledge to an increasing number of new situations, more or less connected to the subject matter itself: ◗ Presentation of diversified problem situations without any indication on the manner of solving them ◗ Presentation of increasingly complex real or simulated situations ◗ Achievement of a performance?? in front of real players ◗ Use of examples, situation scenarios, role play, case studies ◗ Realization in autonomous laboratories ◗ Critical analysis of work carried out by others ◗ Use of self-evaluation

Table translated from Pôle de l'Est, 1996: 119 to 121

The recommended intervention should not be considered linear or applicable as is to each lesson or teaching period. The important thing is to ensure that during the global teaching process, the student will have the opportunity to carry out all the stages. For example, during his learning process, the student can fluctuate between elaboration, organization and application; in the same way, the teacher can focus on methods of elaboration and organization, then return to the stage of elaboration to process additional data, and then return to reorganization, before proceeding to the stage of application. If each lesson is made up of the first three stages of the process, the three final stages may be covered much later in the session; the important thing is that they are all covered.

Support tool 11.A

Five ways to create learning activities for students

By Francine LAUZON, Collège Marie-Victorin[29]

1. Introduce complete tasks that are increasingly complex in situations representative of personal and professional life

Information is better understood, better integrated and more easily recalled if the student builds from it, if he carries out complete tasks (real) in connection with the learning objective of the course.

An effective way of bringing students to construct their knowledge in connection with the learning objective of a course is to allow the students to **contextualize, de-contextualize and re-contextualize the knowledge**. The *contextualization* stage makes it possible for the students to call up their prior knowledge. To achieve this, the student must work on a realistic and complete task that he is familiar with and which the professor knows will cause an imbalance by bringing new questions or new knowledge into the equation. Therefore, the new knowledge will have meaning for the student and be accessible to be developed and deepened in a stage called *de-contextualization*.

The *de-contextualization* stage makes it possible for the students to elaborate their knowledge through presentations by the professor, readings or the gathering of new information by various means. This stage is crucial to absorb the knowledge and prevent it from remaining anchored in specific examples or contexts. However, in order for the student to integrate and re-use this new knowledge, the professor must cause the students to re-contextualize, i.e. **subject the students to new situations of increasing complexity** so that they may use their new knowledge to accomplish new tasks that are complete and increasingly complex.

The initial contextualization of learning and frequent re-contextualization strongly supports the integration and transfer of learning. In this way, as mentioned by Tardif (1999), the sequence of contextualization – de-contextualization – re-contextualization does not occur in linear fashion. Teaching centered on the integration and the transfer of learning demands regular re-contextualization operations.

- I integrate this principle in my practice: often ___ sometimes ___ seldom or never ___
- My *success stories* as a professor:
- Desired changes:

2. Call up students' prior knowledge as well as knowledge introduced in other courses

[29] Text used at Cégep de Rimouski during a pedagogical day, September 25, 2001

Integrated learning rests on **the activation of prior knowledge**. The student must mobilize his own resources if he is to learn, integrate and transfer learning. He must seek to establish links between what he knows and the new knowledge. It is the professor's responsibility to call up the existing learning models of the students (prior knowledge) before introducing new knowledge.

To learn is above all to enrich, correct and reorganize knowledge that we already possess. It is the students' prior knowledge that determines their ability to reach the standards set by the course and also their degree of motivation (Have I seen this material before? Will the course be difficult?).

- I integrate this principle in my practice: often ___ sometimes ___ seldom or never ___
- My *success stories* as a professor:
- Desired changes:

3. Use a specific strategy for each category of knowledge

The different categories of knowledge are acquired according to specific teaching and learning strategies. The two top learning strategies to integrate theoretical knowledge are elaboration and organization. Procedural knowledge presupposes the recognition of procedures and the stages of execution, which we call the cognitive strategies of proceduralization and composition. Let us keep in mind that this type of knowledge commands that some action be taken. To achieve or complete this action, it is not sufficient to understand it, it is necessary to have *a hands-on experience* of it. Conditional knowledge, which is related to the transfer of acquisitions, is integrated through the achievement of tasks or through problem solving in multiple situations, so that the student analyzes and recognizes the conditions which determine the choice of procedures to follow. In this instance, we are referring to the cognitive strategies of generalization and discrimination.

- I integrate this principle in my practice: often ___ sometimes ___ seldom or never ___
- My *success stories* as a professor:
- Desired changes:

4. Recommend varied teaching and learning activities

These activities make it possible for the students to **learn in various ways**. As we know, students have different learning profiles. Some of them visualize what they hear, some hear it, and some repeat it while others need activities to learn. Moreover, certain students learn while reflecting on experiments they conducted while others prefer to apply the theory they

have been taught. To reach the greatest number of students, the professor must vary the way he approaches new knowledge and his way of presenting it.

- I integrate this principle in my practice: often ___ sometimes ___ seldom or never ___
- My *success stories* as a professor:
- Desired changes:

5. Involve metacognition

Cognitive introspection (metacognition) plays an important role in learning. The key word leading to cognitive introspection is *how.* How did I arrive at such a result? Which strategies did I use? What connections can I establish between the question asked and what I know? Or between the new situation and what I have already encountered? What do I recognize in this question or this problem? How could I begin to carry out this exercise? What are the resources (competencies and knowledge) I possess and which ones must I acquire? It is important to question students when they encounter difficulties so that they may identify what they know and what they recognize.

Metacognition refers to the awareness that a person has of his strategies and his personal characteristics, both emotional and cognitive, as well as of his level of control. Metacognition makes it possible for students to manage their learning process and their work methods. A student who recognizes what he knows and when or why he can use it, who knows his learning style and the conditions he needs to learn, can make decisions that will support his success. He becomes autonomous in his learning and masters his role as a student.

- I integrate this principle in my practice: often ___ sometimes ___ seldom or never ___
- My *success stories* as a professor:
- Desired changes:

Support tool 11.B

Five conditions conducive to learning

1. Establish an instructional relationship with the students

Taking time to speak to students and hearing what they have to say; asking them *how they are doing* before beginning the course … This may seem like a waste of time, but

implementing this practice enables students to express certain feelings such as "*I am tired, I feel overwhelmed, it is a beautiful day outside, I'd rather be outside",* etc. These informal chats allow the professor to show his empathy and even, occasionally, help students objectify types of situations. They strongly contribute to the creation of favourable opportunities for students to be receptive and to participate actively in their own learning. In fact, it is like helping the students enter into the spirit of the course, to make them available for what we wish to teach them. In this respect, it is important to remember that knowledge from other courses will also interact on student attitudes vis-à-vis the proposed learning.

The way a professor intervenes in the classroom transmits values that greatly influence the behaviour of students. The dynamics of the professor, his passion and his interest for the subject will likewise influence student motivation. In the same way, his attitude vis-à-vis comments and questions from the students will also communicate a message to them. Have you already calculated how much time the students have to answer a question you ask them?

- I integrate this principle in my practice: often ___ sometimes ___ seldom or never ___
- My *success stories* as a professor:
- Desired improvements:

2. Clearly explain to the students our expectations of what we want them to learn and what they must do

It is the responsibility of the professor to help students grasp the meaning of the activities presented to them in connection with course objectives. Students need to be regularly updated on their progress in relation to the whole of the class (*we covered this…, we are introducing this....and then*…). What is the purpose of the learning?

The role of the professor and that of the students must be clearly defined relative to the learning task; and this must be clearly explained to the students so that they feel they have contributed to the choice of activities they will be carrying out.

The student must be motivated to learn. He must have a goal to reach or a project to complete. This is the condition for the knowledge to have meaning and value for him. Motivation is a condition of learning but, as Tardif (1999) suggests, it should not be regarded as a cause of learning. It can certainly be a consequence of learning for example when the student establishes a pragmatic relation to his knowledge.

A motivated student is receptive to learning, his *brain opens up*. For this reason, the professor must be clear as to his expectations before each course and/or before each new activity in the classroom. The student must understand what he must do and the professor helps him **get going** in the learning project. This could be a matter of listening in order to do a practical exercise or repeating in one's own words; taking notes so as to organize, elaborate and memorize at a later date; asking questions, etc. The professor must advise the student as

to what he must pay attention to and what to do with the information. The nature of these projects has to be connected to the final goal of the course.

Research shows that students tend to consider their role (their profession) generally as an extension of what they learned in school, i.e. they listen to the professor to retain what will be asked on the exam. In this sense, they have everything or almost everything to learn about being a student and what we expect from them.

- I integrate this principle in my practice: often ___ sometimes ___ seldom or never ___
- My *success stories* as a professor:
- Desired improvements:

3. Allot sufficient time for each stage of learning

Learning is carried out in 3 stages:

- Preparation for learning (to be available, to be mentally receptive).
- Data processing and exercise on the learning task to master. this stage is crucial so that students may integrate the new knowledge into their long-term memory and connect it to their prior knowledge. It involves the encoding of information.
- Storage of information and development of automatic reactions through practical exercises and repetition. This period supports long-term memorization.

- I integrate this principle in my practice: often ___ sometimes ___ seldom or never ___
- My *success stories* as a professor:
- Desired improvements:

4. Allow students in the classroom to reflect and learn

The new knowledge must be called up by the student in order to be processed, transferred and preserved in long-term memory. There must be periods set aside for thinking and for doing exercises in the classroom, breaks which allow the student to visualize what has been just covered, to seek an answer to a question or to carry out a task. For example, the student learns by asking questions about a text, by taking notes, by discussing the learning task with other students, by teaching peers, writing abstracts, formulating and criticizing assumptions on the problem. These recall periods in the classroom can be used to show students how to study by encouraging them to schedule these periods outside of classroom hours as well. Each student can be asked to reflect on what he knows about a subject, what he wants to know and finally what he has learned; a method referred to as **KWL:** K (what I know), W (what I want to know) and L (what I learned).

- I integrate this principle in my practice: often ___ sometimes ___ seldom or never ___

- My *success stories* as a professor:

- Desired improvements:

5. Assign work that makes them learn

The work given to the students must be part of the learning sequence. The work must belong to the group of activities that help students acquire learning leading to course mastery and the knowledge to act. Work can thus be initiated on its own or as part of certain activities in class to enable students clearly to visualize what is expected of them. The professor assumes the role of trainer and stimulates the students by showing them paths for correcting or further developing their work.

According to this way of thinking, formative or summative evaluation, including examinations, can be linked to the work which is asked of the students. According to Tardif (1999), it is necessary for evaluation practices to be consistent with the objectives and the activities requested from the students because they will judge what is important based on the content of the evaluations. Moreover, "*it is important that the evaluation content and its requirements respect what has been taught* "[30].

- I integrate this principle in my practice: often ___ sometimes ___ seldom or never ___
- My *success stories* as a professor:
- Desired improvements:

Alternate conditions:

[30] TARDIF, Jacques. 1999. *Le transfert des apprentissages*, Les Éditons Logiques, Montréal, p. 193

2.15
2.16
2.17 Section IV
2.18 Supporting documents

2.19 Document 1
2.20 The learner's concepts are
2.21 the starting point for learning

"Work with to go against"
Andre Giordan[31]

Teaching does not always produce the anticipated results. "The didactic ration, i.e. the amount of knowledge acquired versus time spent, is very poor, sometimes inexistent. Some reasoning "errors" or "erroneous" notions appear again and again among pupils with baffling regularity, even after numerous learning sequences. However when we observe what goes on in the classroom, the overall course seems coherent and logical. On the whole, the lessons appear to be understood.

How should we interpret this? There are undoubtedly many reasons for these difficulties: the large number of students, loss of interest in subject matter, the dispersion of knowledge over multiple disciplines, the diminished aura of the professor, documents that are sometimes illegible, etc. However the main reason may lie elsewhere. Too frequently, the student is the "present-absent" element of the education system. He is present in class, but absent in the eyes of the professor. As a student, he is generally unaware of what he knows (or doesn't know) and does not take his own particular way of learning into account.

To bridge this gap, a number of didactic studies have been undertaken in the past twenty years. The results have made it possible to understand student questions, ideas, thought processes and frames of reference relative to single-discipline or interdisciplinary contents; all the elements that fall under the generic term "conception". The results also show different ways of looking at teaching methods.

What is a conception?
Before they are exposed to any teaching on any subject, students already have preconceived ideas – direct or indirect – on the material to be taught. It is through these ideas that they attempt to understand the professor and interpret the cases or documentation provided. These "conceptions" are stable to a large extent. Learning a new subject and the development of a thinking process are totally dependent on them.

If we do not take these "conceptions" into account, they remain stagnant. The new learning only scratches the surface and students are hardly affected by it.

[31] Source: http://www.unige.ch/fapse/SSE/professors/giordan/LDES/infos/publi/articles/concep.html

Being aware of student ideas and their way of thinking makes it possible for the professor to adapt his practice and offer more efficient teaching. However, let us clarify certain ambiguities.

To begin with, identifying the conceptions of learners does not mean they will be taken into account. Too often in our classroom observations, we see professors ask students to express their ideas but then, they do not act on them. They consider the asking sufficient. Then they continue with their oral presentation, or their teaching in front of the class. To our mind, the expression of students' conceptions is only the initial stage in learning activities. The acquisition of knowledge includes the learning of attitudes, approaches and some "major" conceptions (or basic knowledge). This is not easy to achieve. It is not enough to present a sum of knowledge to a student (teach him more, or teach him better) so that he will understand, memorize and spontaneously integrate it. It is the learner and the learner alone who can elaborate each bit of his knowledge. And to do this, he must rely on the tools available to him i.e., his conceptions.

Secondly, a conception is not what emerges in class i.e., what the student says, writes or does. A conception corresponds to the underlying thought structure which is at the heart of what the student thinks, says, writes or draws.

A conception is not an accident. It is the fruit of the learner's previous experience (whether child or adult). It is his reference for reading, interpreting and predicting reality. It can also be his intellectual prison. This faculty is his only way of comprehending the world. It responds to his interrogations (questions). It uses his reasoning and his interpretations (operating mode) for support; it uses other ideas he is familiar with (his frame of reference), it governs the way he expresses himself (personal meaning) and his way of making sense of things (semantic network). These various elements are obviously not easy to dissociate. They are, as the formula below shows, in complete interaction

CONCEPTION = f (P.R.M.N.S.)

P (or problem) is the set of more or less explicit questions that mobilize and call conception into action. It is the driving force behind all intellectual activity.

R (or set of references) is the set of peripheral knowledge that subjects draw on to formulate their conceptions. In other words, learners rely on other conceptions they've already mastered to generate new conceptions.

M (or mental processes) is the set of all intellectual processes or transformations controlled by the learners. These processes enable them to make connections between elements in their set of references, make inferences, and thus generate and use conception. Specialists call them operatory invariants.

N (or semantic network) is the interactive organization that has been set in place, arising from the set of references and mental processes. It gives a semantic coherence to the whole. In other words, it is the result of the interplay of all the relationships that have been

established between our conception's main and peripheral elements. This process produces a network of meanings, and gives the conception a sense of its own.

S (or signifiers) is the set of notions, signs and symbols necessary for the conception's generation and explanation.

How simple is it to change one's ideas?

It seems abundantly clear that learning is not the result of a simple process of transmission (where the professor says and demonstrates) but rather a process of transformation: the transformation of a student's questions, ideas and thought processes. The professor can greatly facilitate this transformation by "working with" the learner's conceptions and allowing their expression. He can also "work against" these conceptions by attempting to convince the learner that they are mistaken or limited.

These educational notions, originating with the works of Brunner, Ausubel, Piaget and Vygotsky on one hand, and Bachelard on the other, are limiting. Today, it is necessary to go beyond. As such, the allosteric model developed in our laboratory clearly shows that it is necessary to "work with to go against". This is not contradictory! Allow us to elaborate.

Based on research in genetic psychology, certain pedagogues recommend that students discuss as a group task in class, the conceptions that have emerged in the initial stage. This is an excellent method for beginning any learning situation. It supports motivation and question-raising. It makes it possible for learners to take a step back and clarify their thinking. This work on personal conceptions enables students to broaden their perspective, enrich it and evolve personally. The clash of ideas between learners can be provided by a task on reality using small experiments or investigations with older students, via a confrontation with written documents or quite simply by statements put forth by the professor.

Gradually through a series of investigations and progressive structuring, knowledge becomes more elaborate. When it comes to the construction of a conception or the acquisition of a method however, the approach quickly reveals its limitations. There is no way to go beyond the initial conception in situations where the obstacle is caused by prior thinking referred to as an "epistemological obstacle". The approach assumes there is continuity between familiar knowledge and conceptions and that the learner can pass from one to the other seamlessly. However, it is wrong to view conceptions as mere stages in the process of building or to state that "to learn is to enrich ourselves with conceptions" as it reveals a serious misunderstanding that would be dangerous to propagate.

To overcome this difficulty, other pedagogues in accordance with the ideas of Bachelard, recommended correcting the errors of the students immediately. But how do you eradicate a conception? One solution comes immediately to mind: "destroy" the initial conception by introducing the correct conception. A logical deduction! After having located the obstacle, the professor tries to correct it while focusing on the difficulties it brings to light.

We have all used this method and we have realized that, even after multiple tests followed by evaluations, things don't work that way. When an error corresponds to a strongly anchored

way of thinking (conception) and is not simple ignorance, it doesn't matter what explanation is given. It will not change a thing. This never fails to surprise. Even though professorial comments appear relevant, coherent, simple and adapted, the learner generally misses the point. At best, he integrates some bits and pieces while maintaining the "inner core" of his initial idea. A person convinced against their will is of the same opinion still.

To "work with to go against"

Teaching is not that simple or obvious. And there is no universal method that is valid for all students at all times. Fortunately, didactic research can offer a series of tools to help the professor make more enlightened educational choices. What choices?

Initially, it seems it is not only necessary to start from existing ideas but to make them evolve and change. We cannot help but start from 'preconceived' ideas. It is the only tool available to the student to help him decode the situation and its messages. At the same time, these conceptions must be furthered. Knowledge is elaborated on the basis of in-depth remodeling.

However, nothing could be more difficult than to "destroy" ideas already in place. Professors often underestimate the resistance of prior knowledge. A conception never functions in isolation. In connection with a broader coherent structure - the learner's way of thinking with its logic and meanings – a conception tends to resist even the most persuasive arguments. And even becoming aware that thinking is erroneous or limited does not mean a new conception will be understood. Learning requires the development of new relationships, new models, etc.

This is where the allosteric learning model becomes effective. It shows how every acquisition begins with the learner elaborating a new way of thinking (new information that calls his prior knowledge into play); and finally, producing new meanings more apt to provide appropriate answers to his questions.

This process is not immediate; new knowledge "is not understood" immediately by the learner for all kinds of reasons. Initially, he may be missing information. In other cases, the necessary information may be accessible but the learner is not motivated to acquire it, or he is preoccupied by another question. Perhaps the learner is unable to access it due to lack of methodology, means of operation, frames of reference, etc. Finally, he may be missing key elements for effective understanding. In the case of basic learning, the knowledge to acquire does not conform directly to the pattern of prior knowledge and this often creates a problem for its integration.

A radical transformation of the conceptual network is essential. This involves additional conditions. First, the learner must be in a position to go beyond the construct of his prior familiar knowledge and be motivated i.e., have a meaningful reason to do so. Secondly, the initial idea changes only if the learner is confronted with converging and redundant elements that make the conception unmanageable. Thirdly, the learner can only work out a new conceptual network by connecting in a different way to material that is already stored. He must rely on organizational models that structure data differently. On these levels the allosteric model includes a system of parameters or limiting factors, which creates a positive didactic environment.

Alas, constructivist models seem rather crude in educational practice. Learning brings together a series of multiple, polyfunctional and pluricontextual activities. Learning mobilizes several mental organizational levels, which at first seem disparate, as well as a considerable number of regulatory loops. To try to explain everything in a single theoretical framework seems nigh impossible -- all the more so, as the different constructivist models have been produced in extremely specialized fields. For example, in the case of learning scientific concepts, everything does not depend on the cognitive structures as Piaget defined them. Subjects who have attained very developed levels of abstraction can reason out new content just as young children would! What's involved is not only an operating level, but what we call a global conception of the situation, at once a type of questioning, a frame of reference, of signifiers, of semantic networks (including broader overall knowledge of the context and learning), etc. Very many elements orienting the way of thinking and learning, and about which Piagetian theory remains silent.

In the same way, the acquisition of knowledge is not only achieved through "reflective" abstraction. In fact, for scientific learning it can have a deforming or mutating effect. A new element seldom fits into the pattern of acquired knowledge. On the contrary, it more frequently represents an obstacle to integration. To attempt to explain everything in terms of "assimilation" or "accommodation" is very risky. Generally speaking, it is necessary to consider a deconstruction happening simultaneously with a re-construction. The knowledge already in place generally prevents any assimilation of information that is different and remote. Similarly, any accommodation runs up against the model mobilized by the learner. This results in pernicious interferences which block any new elaboration of knowledge.

For learners to be able to grasp a new model or mobilize a concept, their overall mental structure requires a complete transformation. Their framework of questioning needs to be completely reformulated, their network of references largely re-elaborated. These mechanisms are never instantaneous. They pass through phases of conflict or overlapping. Everything is a question of approximation, concernment, confrontation, de-contextualization, interconnection, rupture, alternation, emergence, stratification, stepping back and, above all, mobilization.

Constructivists seem to be largely silent on the contexts and conditions that favour learning. This is frustrating when one is concerned with education or mediation. However this is quite normal; it is not their concern... At best they put forth the idea of "maturation", i.e., natural development, or "equilibration", without specifying the conditions of incorporating such activities in a practice. Vinh Bang is very realistic on the subject. In 1989, he notes with regret that “we are still lacking a psychology of the student”. Actually, we must still elaborate the entire psychology of learning, but is it really psychology?

The allosteric model

Our proposition is very pragmatic and this is undoubtedly why it has experienced success among Anglo-Saxons. It is not designed to produce any additional models of the learner's cognitive processes. Its objective is to decode bit by bit, and in the light of specific knowledge, various types of learning. It appears in the form of a systemic and multi-stratified entity where self-regulating loops and levels of integration are put to the fore. All mastered knowledge is at once the extension of previously acquired knowledge, which provides the framework for questioning, reference and meaning, and a rupture with it, at least by bending it or transforming it through questioning.

Every learning experience represents a change in conceptions. This is never a simple process since the learner is never neutral towards the change. It can even be considered a disagreeable one. The conceptions mobilized by learners provide them with meaning, and any change is perceived as a threat. It changes the sense of our past experiences. The validated conception intervenes at once as an integrator and as a formidable resistor to any new data contradicting the pre-established system of explanations. On top of it, learners must exercise deliberate control over their activity and over the process governing it, at various levels which we will try to enumerate.

All acquisition of knowledge thus proceeds from the complex elaborational activity of learners confronting new information with their mobilized knowledge, then producing new meanings more apt at responding to the questions posed or what they perceive to be the stakes involved. Thus what we call active conceptual sites develop, a sort of interactional structure with a preponderant role in the organization of new information. The didactic environment can impact on these sites in their elaboration of the new conceptual network.

Beyond the description of cognitive strategies, our work is first and foremost didactic. Its aim is to favour the appropriation of knowledge both in and out of school. Although it is only the learners who learn, they cannot do it alone. Between learners and the object of knowledge, a system of multiple interrelations must be set up. This is never spontaneous. The probability of a learner being able to "discover" all the elements needed to transform his questions and continue building networks is practically zero. On the other hand, these approaches can be largely favoured by everything that we call "environment," the learner's disposition not included.

At the beginning of any learning, it is indispensable to have a certain degree of dissonance perturbing the cognitive network formed by mobilized conceptions. This perturbation creates tension, which disrupts or displaces the fragile balance that the learners' brain has put in place. This dissonance creates progress.

At same time, learners must find themselves confronted with a certain number of significant elements (documentation, experimentation, and argumentation) that challenge them and lead them to take a step back, and to reformulate their ideas or debate them. In the same way, a certain degree of limited formalism (symbolism, graphs, schemata or models), some kind of thinking aids, must be integrated in their approach. I might add that a new formulation of knowledge doesn't replace the old unless learners find an interest in it and learn to make it function. At these stages as well, new confrontations with adapted situations and with selected information can be profitable in permitting the mobilization of the knowledge.

For each of them, our micro models serve as tools for deciphering constraints, and forecasting situations, activities, and teaching practices that favour learning.

Through allosteric learning, the whole question of teaching becomes clearer. New functions for science teachers have thus been corroborated. Their importance lies no longer a priori in their lectures or demonstrations. The efficacy of their action is always situated in a context of interaction with the learners' conceptions and cognitive strategies. First and foremost, their role is to regulate the act of learning, to engage the students, to provide orientation and to impart aids in conceptualization.

To find out more:

A. GIORDAN et G. DE VECCHI, Les origines du savoir, Delachaux, 1987. G. DE VECCHI et A. GIORDAN, L'enseignement scientifique, comment faire pour que "ça marche"? Z'Editions, 1989.

B. A. GIORDAN, Y. GIRAULT et P. CLEMENT,Conceptions et connaissance, Peter Lang, 1994

Document 2

Socioconstructivist coaching

"From a socioconstructivist viewpoint, the coach (professor) or accompanying person is placed in a context where change is required and where he must see himself not as a person who *knows*, but rather as someone who *seeks'*"(from Vecchi and Carmona-Magnaldi, 1996, -257). According to these authors, "to construct knowledge means to *change*". When we consider the teaching strategies adopted by the majority of professors (with their emphasis on the transmission of knowledge and importance of *covering* the entire content of the course), we see that adopting a socioconstructivist approach will require many professors to modify their practices and acknowledge their role as coach. They cannot replace the learner, only he can engage in the construction process.

The role of expert generally assigned to the coach is like that of a guide, (…) with an acceptance of a state of imbalance and the taking of pedagogical risks. This new perspective presupposes reflection on current practices and a study of links between these practices and the principles on which they are based.

Socioconstructivist coaching refers to support given in learning situations that facilitates the knowledge building process. The idea is to help students reactivate prior knowledge, establish links with the new knowledge and transfer the fruit of their learning to an actual situation. It requires interaction between the coach and the person being coached[32]."

The table below (translated from Lafortune, Deaudelin, 2001) synthesizes the necessary competencies, prerequisites and inherent conditions to any socioconstructivist approach and the actions which must be taken by a coach.

[32] LAFORTUNE, Louise, DEAUDELIN, Colette, *Accompagnement socioconstructiviste, Pour s'approprier une réforme en éducation*, Presses de l'Université du Québec, 2001, p. 26

A synthesis on a socioconstructivist approach

Socioconstructivist approach: competencies	
Master interpersonal communication in coaching situations	▪ listen actively, speak clearly and display an openness to others ▪ give and receive feedback ▪ verify the interpretation of the message, choose a subject apt to assist the learner in his learning ▪ establish and maintain good interpersonal relationships and remain attentive to this aspect of communication
Know how to moderate and manage a group in a learning situation	▪ assist the group in managing its conflicts ▪ support mutual assistance within the framework of a learning situation ▪ support the achievement of learning tasks
Bring about learning experiences based on theoretical perspectives	▪ plan a learning activity ▪ intervene while respecting theoretical bases ▪ ensure support in the learning situation ▪ evaluate the learning, taking into account the type of coaching
2.22 **Socioconstructivist approach: conditions**	
Prerequisite: *Possess an educational culture*	This educational culture consists of: – Knowledge of main theories in learning (constructivism, behaviourism, cognitivism), – Knowledge of the different facets of coaching (feedback, questioning, metacognition, reflexive practice…), – Knowledge of aspects inherent to teaching (pedagogical methods, evaluation methods…). – Knowledge of topical issues concerning education. Additionally, this academic culture must include the capacity to establish links between various ways of thinking, models and interpretations of teaching approaches, teaching and learning situations. It must also display an ability to confront differing viewpoints. This knowledge and these skills are essential to the creation of cognitive conflicts and the confrontation with concepts that are more or less accurate. Lastly, a coach who wants his students to succeed, needs enough self-confidence to elicit diverging viewpoints and to encourage individuals to justify their ideas.

Inherent condition A: *Foster an emotional climate supporting the construction of knowledge*	In order to create a climate favourable to the construction of knowledge it is necessary to create a climate of mutual confidence. This condition is essential to allow for cognitive conflicts and to exploit a situation without learners feeling judged.
Inherent Condition B: *Agree to take the time needed for constructions to emerge*	It is very easy to give in to the temptation of introducing too many activities to learners in one day. In order to support a socioconstructivist approach, it is necessary to view planning in a different light. It is best if the coach prepares several learning activities; agreeing to take the time and recognizing that not all training activities will be achieved, in order to take advantage of discussions emerging from the group. These discussions are essential insofar as they bring about the confrontation of notions, support co-construction and allow for a deepening of knowledge.
Inherent Condition C: *Agree to adjust learning tools in accordance with the construction process used*	If we agree to support the construction of knowledge, it should be understood that major adjustments may be necessary during the learning. This means that coaches must examine the planned activities in-depth, often giving an impression that the activities are different ones. However, experience teaches the instructor and he develops the expertise to modify activities during the learning and to design new ones without feeling destabilized.
2.23 **Socioconstructivist approach: actions**	
Considering the prerequisite and inherent conditions, a socioconstructivist approach assumes that the coach can accomplish the following actions:	
Cause previously acquired experience to emerge so as to construct new knowledge	To support knowledge construction, learners must identify where their focus must be. By activating their previous experiences (knowledge, skills and attitudes), the learners can focus on that knowledge that will help them integrate the new learning. This practice prevents cognitive overload that learners can sometimes experience when they devote too much attention to knowledge not connected to the subject matter; and that could hinder the construction process.

Provoke sociocognitive conflicts and exploit those that emerge from the discussions	In the course of a learning activity, it can happen that the desired concepts are not being constructed as planned. Rather the erroneous notions remain. To verify the construction of this knowledge, it is important to bring about sociocognitive conflicts that cause the learners to experience problematic activities: unsettling their notions and causing social interactions that bring about the emergence of sociocognitive conflicts in the exchanges of ideas.
Co-construction through action	In order to successfully coach a learner in a socioconstructivist perspective, it is necessary to learn to co-construct through action, which means to: ▪ Be ready to call our definitions into question ▪ Be attentive to ideas expressed, no discrimination at first sight ▪ Have acquired skills to create diagrams and syntheses of discussions ▪ Be able to do an analysis to highlight what distinguishes the various concepts put forth by the members of the group.
Shed light on erroneous concepts	The importance of causing cognitive conflicts leading the learners to call into question their erroneous notions has already been emphasized. In order to take into account the evolution of the group in question, it is necessary sometimes to maintain these erroneous perceptions until a later time in the learning activity. It is not always necessary or desirable to confront them at the moment they are expressed.
Make the most of moments when constructions bring about awareness	Persons who are coached during the construction of knowledge make adjustments to their concepts. Making the most of these moments to help learners become aware of constructions or of the different ways to structure knowledge supports the development of metacognitive skills.

Document 3
Learning Principles

DISCAS Guide's Frame of reference

This document constitutes the heart of educational thinking developed for many years now by DISCAS as concerns the links between study programs on one hand and the learning process of young people[33] on the other.

General didactic principles

Québec's thinking vis-à-vis education, particularly that of the ministère de l'Éducation, offers certain constants for all course programs and prescribes **a way of teaching** that presents specific characteristics.

Every pedagogical practice including intuition, relates to a concept of learning and thus a concept of teaching. When this concept is explicit and coherent and has an impact on the school educational environment, it is called an educational **model**, not in the sense of a model to be followed or imitated, but of a coherent set of teaching principles.

Each model perceives the student and learning in a certain way. Let us review some of the past models used in Québec.

In **traditional** education, the student was a receiver and a storehouse of knowledge, an unformed ball of wax to be shaped entirely by external models. This style of teaching favoured the lecture and the imitation of models. In the **behaviourist** model, the perception of the student was of someone conditioned to behave in certain ways by stimuli and then, repeating the stimulation until the correct response was received: the stage of micro-teaching and programmed exercises. For its part, **non directed** education makes the assumption that the student is naturally predisposed to learn and should be left free to do so. Teaching fades and efforts are largely concentrated on arranging a favourable environment in which the student chooses his own way of progressing.

For the past forty years, Québec has oscillated between these models before finally achieving a rather broad consensus - in theory if not always in practice - around a notion of learning that originates with Piaget and later called **cognitive** - the name we will use herein - and which underwent various incarnations, the most recent being cognitive inter-structuring and strategic teaching.

Beyond the current buzzwords and the jargon of specialists, the concept which has been used as the basis of all programs can be summed up in a few simple principles. These are **general didactic principles** (**GDP**):

[33] Taken from: http://discas.educ.infinit.net/Cadreref/Documents/principesImpacts.html

GDP 1 ***It is the student who does the learning***. To learn is an active process which requires that the student be engaged and mobilized. It is what we mean when we say that *a student is a learning subject* or that he is *the agent of his own learning*.

GDP 2 ***The student must be motivated to learn***. It is necessary for the student to have a minimum amount of motivation and confidence as regards the learning and to know that what is asked of him is meaningful.

GDP 3 ***The student learns in order to act***. The learning must make it possible to carry out actions and to accomplish tasks which were inaccessible before. Without being exclusively utilitarian, learning must be useful and find applications in "real life". This is exactly what we mean when we say that the acquisition of knowledge can only be justified in the context of developing competencies.

GDP 4 ***The student learns by doing***. It is through personal experience, concrete manipulation and the achievement of tasks, that the student internalizes information and learning strategies.

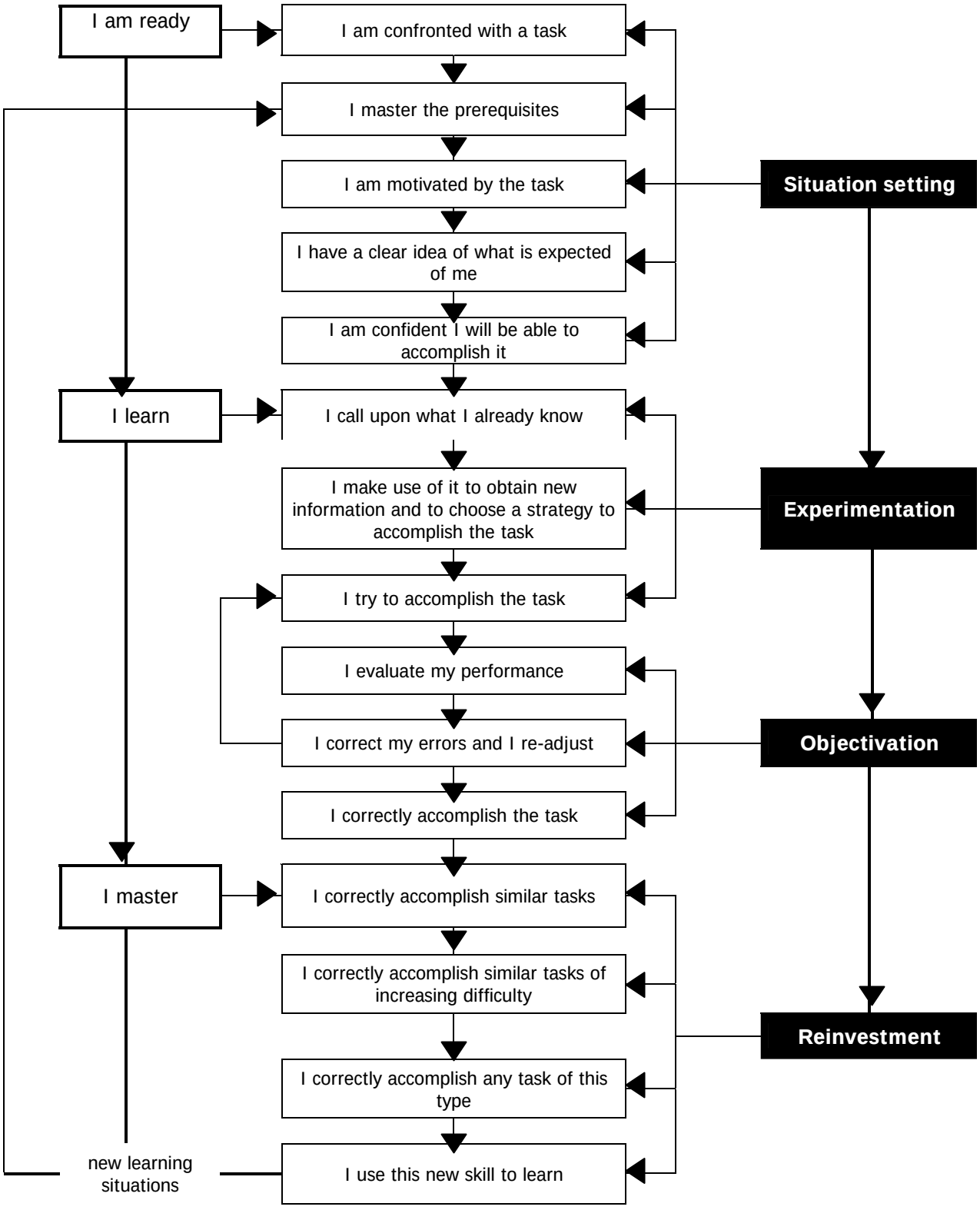
GDP 5 ***The student learns by watching himself act.*** The goal of learning is to correct errors. However, errors also help us learn. This happens when the student gets to know himself and compares himself to others, identifies his errors and successes, knows what leads to errors and what strategies lead to success, and why. Consequently, learning must integrate stages of feedback, objectivation, metacognition, etc.: a series of technical terms meaning a reflecting on what was done to better succeed at what we want to do.

GDP 6 ***The student uses strategies to learn***. Even when he seems to be learning little or poorly, the student does not learn randomly. He begins with what he knows and connects new situations to that. When a method functions well, he will re-use it until he discovers limitations or he discovers a better one. He will easily generalize and give himself recipes and rules. Teaching must capitalize on this ability by making the strategy explicit and then supporting it.

GDP 7 ***The student learns based on what he already knows***. Faced with a new situation, he tries to find known elements and familiar structures which can be used as benchmarks. Before inventing new strategies, he will test those he already knows. In short, he calls upon his experience and his prior knowledge in order to learn.

The following chart, **general learning process,** illustrates and summarizes the learning process described by these didactic principles.

General Learning Process



Document 4

2.24 Planning the development of a competency based on a typical learning process[34]

Learning process	Practical application in a competency-centered approach	Means of learning
Activation: awakening of student's cognitive and emotional acquisitions in relation to the competency and knowledge	***On the emotional level***: to stimulate student motivation by stressing links to the competency, the relevance of the knowledge, the relevance of the learning tasks and their feasibility, etc. ***On the cognitive level***: to have the student carry out a task connected to the competency based on previously acquired knowledge. If the acquisitions are not sufficient, a task relating to a familiar subject can used as an analogy for the competency or knowledge.	**Emotional level:** • discussion with students on the relevance of the desired goal; its link to the development of the competency; • highlighting a stimulating application; • emphasizing the student's ability to succeed; **Cognitive level:** • work on simple cases; • individual questioning and in teams; • pooling; • request for simple examples from the students; • recall by students of knowledge acquired in previous courses with or without the assistance of documentation
Elaboration: the student establishes connections, correct or erroneous, between what he knows and what he learns and what he seeks to understand.	To require that the student make assumptions about the cases, phenomena and knowledge; to require they provide explicit justification.	• brainstorming; • explanation of problem cases, request for explanation of unusual laws or phenomena, explicit justification of the assumptions advanced; • request for explanation of contradictory phenomena and diverging viewpoints among students; • confrontation of student explanations by the professor

[34] Pôle de l'Est, 1996:216-218

Planning the development of a competency based on a typical learning process		
Learning process	**Practical application in a competency-centered approach**	**Means of learning**
Organization: learning must lead to a clear and correct structuring of knowledge in every student.	One of the preferred methods begins with the professor presenting the relevant concepts and procedures. This presentation is not enough to guarantee that the structuring will take place in the student. Activities like schematization by the student, the modeling of cases by the student, the drafting of summary sentences, the description of the relationships between the concepts, etc. can be used as learning tools. It is up to the student to develop his own structure of knowledge, with assistance.	• use of structuring in order to help the student establish relationships; • conceptual diagrams and procedures used by the professor; • schemas developed by the student; • summary sentences; • abstract; • description of the relationship between key words; • use of examples to illustrate the acquisitions.
Application: to use the conceptual and procedural knowledge acquired at the stage of organization, with decreasing assistance and support,.	A competency cannot develop if the knowledge is not used by the student. Initially we will present simple cases to process, with suitable assistance. We stress here the importance of having the student justify his choices and applications, based on relevant concepts and procedures.	• request for application using tools; • description of the approach used; • search for examples and non-examples by the student; • exercises, demonstration and problem solving with feedback; • explicit interpretation of problem cases solved by others.

Planning the development of a competency based on a typical learning process		
2.24.1.1.1.1.1.1 Learning process	**Practical application in a competency-centered approach**	*2.24.1.1.1.1.1.2 Means of learning*
Proceduralization: to use structured acquisitions in increasingly complex situations to develop the ability to act quickly while remaining effective. To implement stages necessary to make problem solving increasingly 'automatic'.	The student must be placed in front of increasingly complex cases. In doing so, the implementation stages and explicit use of the relevant knowledge will become increasingly easy. The explicit written formulation of each stage by the student will support the metacognitive process. Proceduralization however, requires that support (assistance, documentation, steps) be reduced gradually as well as the time allotted for the task.	• request for application to problem cases with increasing contextualization; • situation scenarios, role play, laboratories that become increasingly complex, case study; • identification of personal examples; • self-evaluation.
Integration: increasing autonomy in the implementation of acquisitions connected to the development of competencies. The ultimate goal of learning is the integration of new learning in the student's structure of knowledge and his way of approaching situations.	How can we know if a student has integrated the learning? One way is to confront the student with a new case; in a context where he is not told that he will be required to apply such or such a procedure. He must then identify the nature of the treatment to be applied, model the case correctly, solve it and justify his choice. This will gradually support a transfer of acquired knowledge to new cases. This transfer will also occur in cases more or less connected to the subject matter itself. (For example, to ask the student in a mathematics course to solve integrals with concepts used in physics). This processing obviously supports metacognition by the student, and is in turn supported by teaching itself, especially at the outset of the development of a competency.	• presentation of diversified problem cases without indication on how to solve them; • real or simulated cases of increasing complexity; • use in authentic situations; • examples, scenarios, problem cases, role playing, case study; • autonomous laboratories; • critical analysis of work carried out by others; • self-evaluation.

Document 5

Educational principles behind the implementation of study programs

Application of educational principles in the implementation of study programs[35]

The conclusions drawn from research in cognitive psychology outline five major pedagogical principles that can be used to make a critical examination of educational practices implemented. These principles are also used to establish the orientation that should impact program implementation.

Educational principle	The student	The professor	School administration	Educational services	General directorate
1st principle: Learning is an active and constructive process.	- Constructs *his knowledge* in a personal and progressive way according to an active interior process; - Learning is defined by the discovery and construction of meaning based on information or a learning experience.	- Gets to know *the orientations* of the study programs personally and progressively, by engaging himself actively in the process; - The acquisition of orientations and content of the study program is defined by the discovery and construction of meaning based on information and *concrete experiences*.	- Gets to know *the orientations* of the study programs personally and progressively; seeks to produce a coherent and meaningful model for himself, for the application of these orientations in the support of teaching personnel.	- Understands that the various categories of personnel do not all process data and experience in the same way or on an equal footing. It is his task to create an environment favourable to the construction of pedagogical knowledge, playing the role of mediator and trainer in this process.	- Knows, understands and endorses the principles and orientations of the study programs; supervises the application of these orientations and checks the knowledge, comprehension and application of the study programs for the various categories of personnel as well as their adhesion to the orientations.
2nd principle: Learning is primarily the creation of connections between new material and prior knowledge.	- Processes information by connecting it to the knowledge already stored in his memory. - A great deal of attention must be given to the prior knowledge of the student, since this constitutes the filter through which the new material is treated.	- Processes the orientations and contents of the programs according to the learning models, the knowledge and the practices already stored in his memory. - The pedagogical knowledge and know-how of the professor are the filter through which is treated the new data relating to the orientations and the contents of the study programs.	- Clearly visualizes the data concerning the current pedagogical practices of his school and establishes connections with the pedagogical data underlying the application of the study programs.	- Understands that the application of the study programs cannot be carried out without being related to current pedagogical practices, and plans learning situations which allow the construction of new teaching practices.	- Indicates clearly the changes to be made to current pedagogical practices and recommends a reflection period on the pedagogical practices to actualize in his educational environment.
3rd principle: Learning requires the constant	- A student who is expert at learning is able to organize the knowledge	- The ongoing learning relating to the study program must	- Facilitates, through genuine communication between	- Plans for the creation of an ongoing learning environment	- *Is aware* that the various categories of school staff organize the

[35] Translated from Nicole Tardif, « Pour réussir la mise en œuvre des programmes d'études : un processus continu », Vie pédagogique, no 110, February-March 1999, p. 37-41.

Educational principle	The student	The professor	School administration	Educational services	General directorate
organization of knowledge.	which he stored in long-term memory. This student has created many links between various knowledge relating to the same reality, and these links, i.e. this organization, not only enables him to easily recover the knowledge which he has in memory, but also to process several data or to re-use various knowledge simultaneously.	make it possible for the professor to have a coherent and meaningful model of the pedagogical practice that he is to privilege and to gradually reorganize within his teaching the interventions and strategies that need to be implemented.	professors, exchanges and the sharing of knowledge and experiences relating to learning. - The learning of new educational practices is easier when the professors have the opportunity discuss the strategies they have used.	which supports and respects the diversity of knowledge and pedagogical know-how, offers other pedagogical perspectives, develops reflexive thought, gives access to other perceptions and generates new knowledge.	information they receive in a personal way, since individual acquisitions and experiences can differ substantially and that, in addition, when put in the presence of information, each individual naturally attempts to give it a personal meaning.
4th principle: Learning involves declarative knowledge as well as procedural and conditional knowledge.	- In cognitive psychology, the distinction between different types of knowledge is crucial: knowledge is either declarative (what), or procedural (how to), or conditional (when and why to use declarative and procedural knowledge). - Based on this distinction, knowledge is visualized differently by the student and stored differently in memory. This diversified knowledge is mastered using modeling, guided practices, cooperative practices and autonomous practice.	- Establishes coherent pedagogical practices pursuant to the assimilation, comprehension and application of the orientations and the contents of the study program, the differentiated conceptual models of this knowledge, whether for declarative, procedural or conditional knowledge.	- Is concerned with offering professors, as part of their ongoing learning, the opportunities to acquire and apply various types of knowledge in varied and integrated situations in various fields of learning.	- Promotes the participation and coaching of the various categories of personnel in the acquisition of the declarative and procedural knowledge related either to the study programs, or to the maintenance or implementation of adapted pedagogical practices. Coaching is characterized by modeling, guided practice, cooperative practice and autonomous practice.	- Takes into account this principle in his vision of the system, given its consequences for educational practices for teaching, learning evaluation, instructional management, professor training and the role of parents.

Educational principle	The student	The professor	School administration	Educational services	General directorate
5th principle: Motivation determines the degree of engagement, participation and persistence of the student in his learning.	- Emotional variables such as self-image, feelings of competence and security, influence behaviour in learning situations. What motivates students at school includes the following factors: their concept of intelligence, the goals pursued by school, the perception they have of the value, requirements and controllability of the task.	- The professor's motivation in the application of the study programs includes the following factors: the concept of learning and the goals targeted by program curriculum reform; the perception he has of the value, requirements and controllability of the task required by this implementation.	- The beliefs of the administration are determining factors in the application of the study programs. - Based on this principle, the motivation of the administration determines the degree of professor engagement in the adaptation and the enrichment of educational practices. This is one component on which the local school administration can have a considerable impact.	- Provides to the various categories of personnel with the strategies they need in the application of the study programs and pays special attention to their perception of the control they have over the learning tasks.	- Is aware from past experience that implementing programs results in emotional reactions, either positive or negative Is also aware that the motivation of the personnel plays a paramount role in the application of the study programs.

Document 6

Students at the center of their own learning[36]

Student-centered learning (SCL), or learner-centeredness, is a learning model that places the student (learner) in the center of the learning process. In student-centered learning, students are active participants in their learning; they learn at their own pace and use their own strategies; they are more intrinsically than extrinsically motivated; learning is more individualized than standardized. Student-centered learning develops learning-how-to-learn skills such as problem solving, critical thinking, and reflective thinking. Student-centered learning accounts for and adapts to different learning styles of students.

Student-centered learning is distinguished from teacher-centered learning, which is characterized by the transmission of information from a knowledge expert (teacher) to a relatively passive recipient (student/learner) or consumer. According to McCombs and Whisler (1997), learner-centered learning is

> the perspective that combines a focus on individual learners (their heredity, experiences, perspectives, backgrounds, talents, interests, capacities and needs) with a focus on learning (the best available knowledge about learning and how it occurs and about teaching practices that are most effective in promoting the highest levels of motivation, learning and achievement for all learners).

Principles of student centered learning

The learner-centered model reflects the necessity of a focus on both learners and learning. Several features characterize student-centered learning. Students have opportunities and increased responsibility to identify their own learning needs, locate learning resources, and construct their own knowledge based on those needs (rather than having a standard or identical knowledge base imparted to all students).

McCombs and Whisler (1997) developed **12 major principles** of student-centered learning that relate to the following areas:**:**

1. The nature of the learning process
2. Goals of the learning process
3. The construction of knowledge
4. Higher-order thinking
5. Motivational influences on learning
6. Intrinsic motivation to learn
7. Characteristics of motivation-enhancing learning tasks
8. Developmental constraints and opportunities
9. Social and cultural diversity
10. Social acceptance, self-esteem and learning
11. Individual differences in learning

[36] Summary of an article found at: http://www.intime.uni.edu/model/center_of_learning_files/principles.html University of Northern Iowa's College of Education, 2001 INTIME (Integrating New Technologies Into the Methods of Education)

12. Cognitive filters

1. The nature of the learning process: McCombs and Whisler (1997) defined the learning process as a natural inclination to pursue personally meaningful goals. This process is active, volitional, and internally mediated. It is a process of discovering and constructing meaning from information and experience, filtered through each learner's unique perceptions, thoughts, and feelings. Learning becomes an active process, in which the student is constantly engaged in a task. Being so involved, the student seeks his/her own underlying meaning. One of the goals of active learning is to have the classroom activities focused on "reasoning and the evaluation of evidence, thus allowing the students the opportunity to develop the ability to formulate and solve problems".

2. Goals of the learning process: McCombs and Whisler (1997) stated that "the learner seeks to create meaningful, coherent representations of knowledge regardless of the quantity and quality of data available". To accommodate the goals of the learning process, the INTIME Model (Integrating New Technologies Into the Methods of Education) stresses the concept of *making meaning*. This element of the INTIME Model is one of the most persistently honoured goals of teaching. By focusing on in-depth understanding, the quality of learning is greatly enhanced. Teachers are more likely to see what students do know and understand. Helping students acquire understanding is a difficult task. We commonly find that our students understand much less than we had hoped for. That is why teachers employ different strategies to develop students' understanding. According to Stiggins (1997), "The most valuable lesson we have learned in recent years from those studying cognitive processes is that rote memorization does not ensure understanding, and thus is not a powerful way to promote learning"

The INTIME Model seeks to promote the "development of mature thinkers who are able to acquire, work together and use knowledge which means educating minds rather than training memories" (Adams & Hamm, 1996, p. 27). "Social constructivist teachers help their students understand that they are co-constructors of knowledge, that they can make sense of things themselves".

3. The construction of knowledge: This concept means that the learner links new information with existing and future-oriented knowledge in unique and meaningful ways. It also means that students need opportunities to do more than just receive information. Although knowledge acquisition processes are needed to form the base, the knowledge is useful to the degree it can be applied or used to create new knowledge. The INTIME Model refers to the construction of knowledge in the Information Processing section, which is divided into Interpretation, Pre-search, Search, and Evaluation. The model stresses Information Processing approaches because these approaches regard the human mind as a symbol processing system. The symbol converts sensory input into symbolic structures (propositions, images, or schemes), and then processes (rehearses or elaborates) those symbolic structures so knowledge can be held in memory and retrieved. The outside world is seen as a source of input, but once the sensations are perceived and enter working memory, the important work is assumed to be happening "inside the head" of the individual.

Under Information Processing, *Interpretation* reinforces the construction of knowledge because "it is important for students to practice their understanding". "Interpretation requires

the learner to identify the major ideas in a communication and understand how various parts of the message are interrelated".

4. Higher order thinking: This represents the higher order strategies for "overseeing and monitoring mental operations, facilitating creative and critical thinking and the development of expertise". Educational reformers wish to teach students how to ask questions, build their own interpretation and ideas, clarify and elaborate upon the ideas of others. If students are to be independent learners at the center of their own learning, according to Berliner and Benard (1995), they need to develop a sense of their individual identity, acquire the skills to act independently, and have some control over their environment.

Power Sharing is a very important feature of today's education because "sharing various interpretations of a material adds an extra dimension in the learning process as students not only learn how others perceive a certain issue, but also appreciate the various reasoning processes and life experiences that support different interpretations".

5. Motivational influences on learning: These influences reflect the importance of learner beliefs, values, interests, and goals, expectations for success, and emotional states of mind in producing either positive or negative motivation toward learning. The depth and breadth of the information processed and what and how much is learned and remembered are influenced by (a) self-awareness and beliefs about personal control, competence and ability;
(b) clarity and saliency of personal values, interests, and goals;
(c) personal expectations for success or failure;
(d) affect, emotion, and general states of mind; and
(e) the resulting motivation to learn..

Research also shows that when students make connections between their own identity and the school, these connections foster lifelong learning and development of important skills. The motivation to learn has four dimensions: behavioural, humanistic, cognitive, and socio-cultural. Behavioural motivation is expressed through reinforcers, rewards, incentives, and punishers. From a humanistic point of view, the motivation to learn is characterized by a need for self-esteem, self-fulfillment, and self-determination. The cognitive motivation to learn is represented by learners' beliefs, attributions for success and failure, and expectations. The socio-cultural motivation to learn is realized through engaged participation in learning communities and by maintaining identity through participation in group activities. Part of this ability comes from an awareness and tolerance of cultural differences.

6. Intrinsic motivation to learn: The continuing impulse to learn is characterized by intense involvement, curiosity and a search for understanding. Intrinsic motivation to learn refers to the fact that individuals are naturally curious and enjoy learning, but intense negative cognitions and emotions (e.g., feeling insecure, worrying about failure, being self-consciousness or shy, and fearing corporal punishment, ridicule, or stigmatizing labels) thwart this enthusiasm. To promote students' readiness to learn, "social constructivist teachers are likely to focus their efforts on helping their students find their passions, discover what they care about, create their own learning agendas, and most importantly, connect what they are to what they do in schools". A socioconstructivist professor knows that what students understand today determines what they will learn later.

7. Characteristics of motivating learning tasks: These include curiosity, creativity, and higher order thinking, which are stimulated by relevant, authentic learning tasks of optimal difficulty and novelty for each student. Encouraging creativity in a classroom means to accept and encourage divergent thinking, to tolerate dissent and encourage students to trust their own judgment.

8. Developmental constraints and opportunities: This refers to how individuals progress through stages of physical, intellectual, emotional, and social development that are a function of unique genetic and environmental factors. These factors make each individual different because students possess different kinds of minds and therefore learn, remember, perform, and understand in different. Howard Gardner's theories of Multiple Intelligences and Dunn's Learning Style Model respect these personal characteristics of students.

9. Social and cultural diversity: Learning is facilitated by social interactions and communication with others in flexible, diverse (in age, culture, family background, etc.), and adaptive instructional settings. To stress the idea of social and cultural diversity, the INTIME Model promotes the ideas of Civil Involvement with Others, Communication, and Tolerance to emphasize the importance of developing students' interpersonal skills and interactions among students.

Communication involves the relationships between students or between the teacher and the students. Cooperative learning is a teaching strategy that enables most students to communicate with each other while learning, and to participate in peer learning. *Tolerance* is the element of the INTIME Model that shows that children need to be friendly, cooperative, approving, affectionate, and willing to share. Students who live in a democratic society need to develop compassion, cooperation, and the ability to accept responsibility for their actions. When talking about civil involvement with others, the INTIME Model stresses an "important strategy, which is to help the children create a collective identity, a sense of themselves as a group rather than a collection of individuals". The purpose is to foster social bonding; that is, to help children perceive their connections to one another.

10. Social acceptance, self-esteem and learning: Learning and self-esteem are heightened when individuals are in respectful and caring relationships with others who see their potential, genuinely appreciate their unique talents, and accept them as individuals. Social acceptance fosters interactive instruction because in a social setting, skilled thinkers model critical and creative thinking, thereby exposing novices to what is normally invisible. Thus, the "teachers have multiple opportunities to move students toward critical and creative thought".

11. Individual differences in learning: Learners have different capabilities and preferences for learning modes and strategies. These differences are a function of environment (what is learned and communicated in different cultures or social groups) and heredity (what occurs naturally as a function of genes). The students are different from one another, and thus, they reason and learn in different ways, hence the importance of varying the teaching methods.

12. Cognitive filters: These consist of personal beliefs, thoughts, and understandings that result from prior learning and interpretations. They become the individual's basis for constructing reality and interpreting life experiences. Daily activities require the exercise of

critical thinking. Each individual is constantly solicited, through the accomplishment of multiple tasks, to elaborate, interpret, generalize and think in an independent way. Feedback helps to accomplish these tasks in a considered and productive way. There is learning when there is a modification in personal concepts.

Student-centered teaching

In a student-centered classroom, learners need three things for learning – individualization, interaction, and integration. Thus a student-centered curriculum teaches each learner to select and sequence his own activities and materials (individualization); arranges for students to center on and teach each other (interaction); and interweaves all symbolized and symbolizing subjects so that the student can effectively synthesize knowledge structures in his own mind (integration). To achieve these things requires "pedagogical content knowledge" which is the understanding of how students think about the subject matter to be understood, including the ways they tend to misunderstand and forget it. A good part of pedagogical competencies deal with the manner in which to teach students a given content.

Classroom Management is important in a student-centered classroom. Its goals are to allocate more time for learning, to give more access to learning, and to help students develop their self-management. The INTIME Model of student-centered learning focuses on the idea of self-control because through self-control, students demonstrate responsibility–the ability to fulfill their own needs without interfering with the rights and needs of others. Students learn self-control by making choices and dealing with the consequences, setting goals and priorities, managing time, collaborating to learn, mediating disputes and making peace, and developing trusting relations with trustworthy professors.

Encouraging self-management requires extra time, but teaching students how to take responsibility is an investment well worth the effort. Socioconstructivist professors help their students understand that they are co-constructors of knowledge, that they can make sense of things themselves, and that they have the power to seek knowledge and to attempt to understand the world.

When professors respect multiple constructions in this way, students engage more intensely in their learning. When students feel that they can succeed or that challenging enterprises will make them better at something, they feel a sense of self-worth.

Document 7
Differentiating types of knowledge

To properly understand what occurs during learning, it is necessary to question (observe, collect material, analyze, etc.) the nature of the cognitive processes involved in various activities and learning tasks.

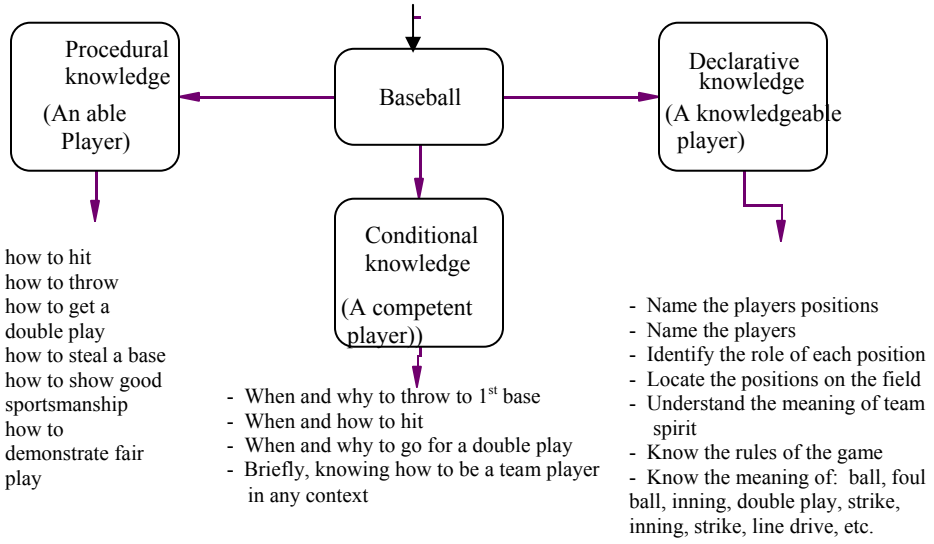
Description of the cognitive processes involved in processing various types of knowledge [37]

According to cognitivism, learning operates with 3 types of knowledge or know-how: *declarative knowledge* (what, the essence of things), *procedural knowledge* (how, the know-how, the sequence of actions) and *conditional knowledge* (when, conditions of using declarative or procedural knowledge, how to, if…).

Martineau (1999) provides the example below that illustrates how these 3 types of knowledge contribute to the mobilization of a competency.

Three types of knowledge

Baseball player training formula



Research in cognitive psychology has shown that some methods of processing data seem more implicated than others in the acquisition of specific types of knowledge and know-how.

Studies also show that each of these types of knowledge is acquired through two aspects of data processing known as cognitive processes, shown in the table below.

[37] Raymond, 2001: 17-21

Cognitive processes used in the learning
of different types of knowledge

Knowledge	**Process**	
2.24.1.1.1.1.1.3 Declarative	Elaboration	Organization
Procedural	Proceduralization	Composition
Conditional	Generalization	Discrimination

Let us examine these types in closer detail to better understand what they are and how they are learned. In theme 5, we will see how it is possible to support the student in his own learning through teaching interventions.

2.25 Declarative knowledge and know-how[38]

Declarative knowledge is theoretical knowledge that refers to facts (dates, names, places, events, etc), to principles and laws or concepts. For example: the concept of federalism in Québec, the rise of Hitler to power, the October Crisis dates and the cause of the crisis, knowledge of grammar rules and mathematical formulas, etc.

This knowledge is built according to 2 mental processes called *elaboration* and *organization*.

Elaboration: Any mental activity carried out by a learner that adds to the information in long-term memory is part of the process of ***elaboration.*** A new link is forged and organized in networks as shown in the figure below.

Organization: In the process of ***organization***, a restructuring takes place which allows the structuring of information in significant subsets whose connections are highlighted. This organization makes it possible to retrace information in memory at the time when it is needed.

[38] As we mentioned earlier, these two terms are not synonymous. By knowledge we mean that which belongs to the student and by know-how the content to be acquired, within the perspective that acquired knowledge must be transformed by the student into know-how. It all depends on our starting point. thus some knowledge will be transformed by the student into know-how.

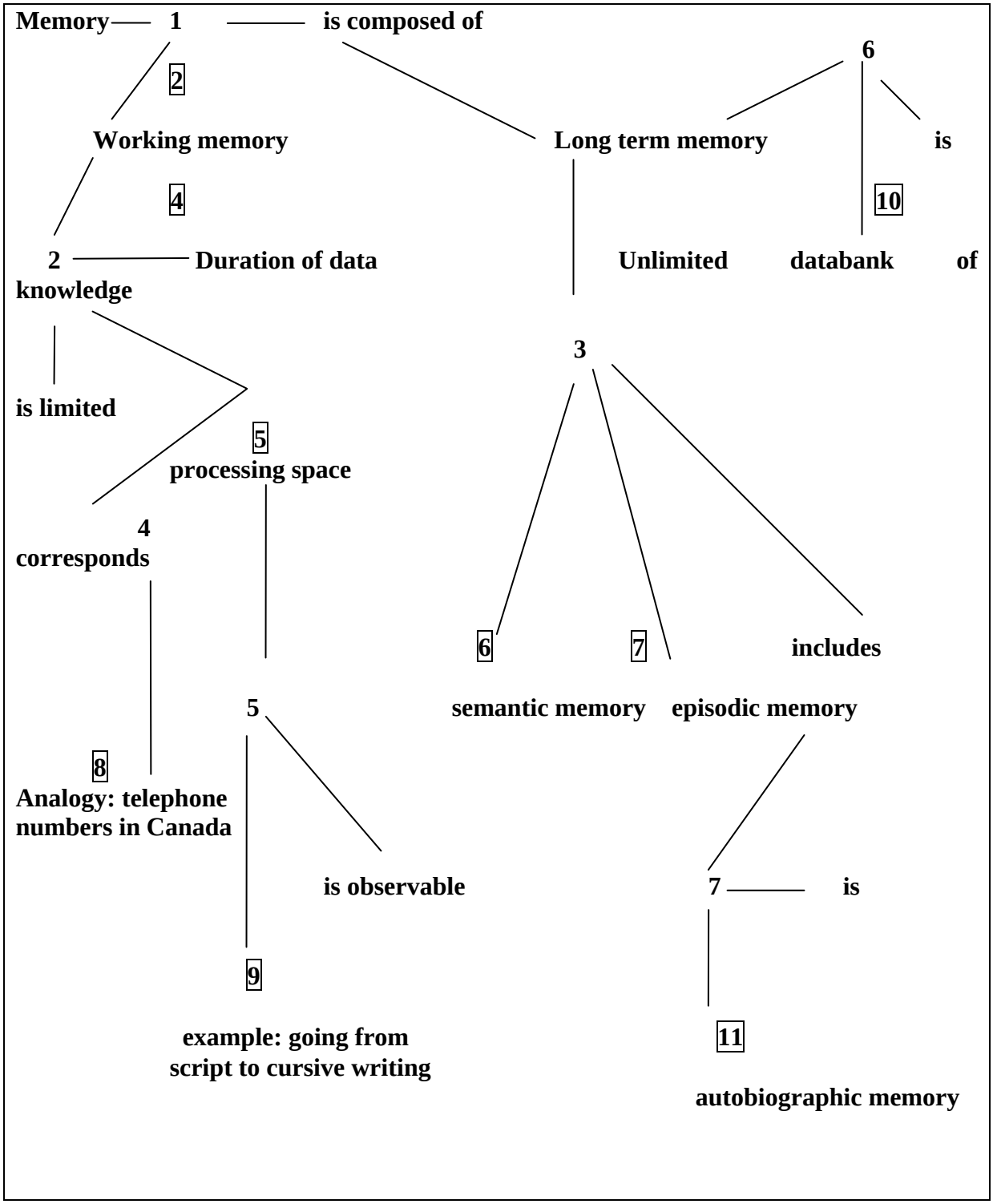


Fig. 3B: Semantic network of the architecture of memory
* the use of the square indicates an access path to knowledge

Declarative knowledge is generally "static" versus dynamic and must be translated into procedural and conditional knowledge (procedures and conditions) to enable action." (Tardif, 1992: 48)

Procedural knowledge and know-how

Procedural knowledge is knowledge that refers to how an act is done and the stages and procedures through which it is carried out. For example, implementing the steps required for a literary analysis, performing a chemistry experiment in a lab, building an electronic circuit, administering an intramuscular injection, studying a text, taking notes, etc. These are ways of doing things, different types of know-how.

Know-how is connected to procedural knowledge (to know the steps of a literary analysis, a declarative type of knowledge) and procedural know-how (to be able to produce the literary analysis). For instance, knowing the steps in an analysis does not guarantee the information will be extracted accurately. This is an important aspect from a teaching perspective. Conditions must allow the student to acquire procedural know-how. Procedural knowledge can only be integrated by the person performing the activity necessary for its acquisition.

When the professor acts on this type of knowledge, he forces the student into action. The student is guided in the acquisition of know-how and procedures. The professor works with him to objectify his methods by providing feedback and information on the student's performance.

The two mental processes involved in learning procedural knowledge are *proceduralization* and *composition.* What differentiates one from the other is a question of degree or level. Whereas *proceduralization* allows for the learning of each action, *composition* engages the automatic mechanisms necessary for the effectiveness of the action. For example, a nurse must be able to install a urinary probe without stopping to read what to do at each step of the process, just like an airline pilot lands his plane without referring to the instructions at each stage of the landing procedure.

Through ***proceduralization***, we are able to recognize the stages of a procedure and are able to carry them out one by one. At this stage however, they are not yet automatically connected to one another.

Through ***composition***, we gradually automate the use of the procedure and through repeated practice the sequence becomes automatic, thus we gain a more global awareness of the actions.

2.25.1.1.1.1.1 Conditional knowledge and know-how

Conditional knowledge is knowledge that refers to the conditions needed to accomplish an action or strategy. It is the when, why and conditions needed to do it. After careful study of these circumstances, the best strategy and procedure will be identified. The choice will fall on that which has proven the most relevant in other contexts and in the resolution of other problems. For instance, the best strategy in problem solving is one that guides us to ask the right question; what strategy do we use to parse a sentence, drive a car in the fog or freezing rain, prepare and carry out a conference for novices in the field versus experts?

Whereas procedural knowledge corresponds to a sequence of actions, conditional knowledge corresponds primarily to classifications and categorizations: when and why do we act this way. It is acquired through the mental processes of *generalization* and *discrimination*. ***Generalization*** allows for the identification of common characteristics in situations where a specific knowledge is applied. It also makes it possible to broaden the field of application to other applications recognizable by the student. ***Discrimination*** makes it possible to restrict the number of situations to which the knowledge applies, by including specific requirements for its application.

These two processes are carried out through practical tasks and transfers. The professor should provide the student with meaningful and complete tasks, where he will have to recognize the conditions for use of his knowledge, i.e., when, where and why.

To conclude

We often try to transpose "*knowledge, know-how and personal conduct"* to the knowledge types outlined above. But there is no correspondence. Even though we can easily associate knowledge to declarative knowledge and know-how to procedural knowledge, conditional knowledge is still considered know-how.

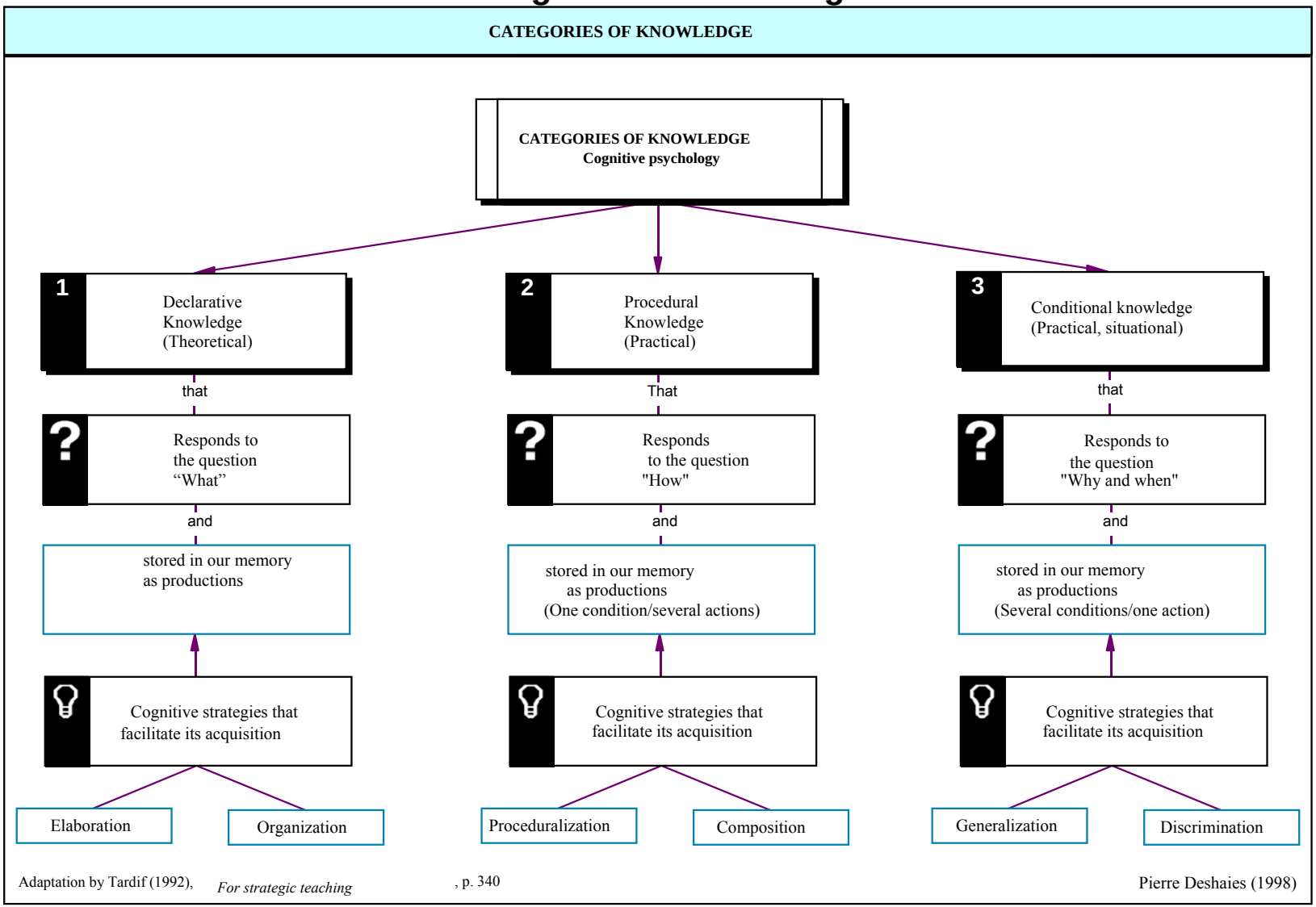
In addition, what is called *personal conduct* is quite different in nature. As shown by Martineau, this is not knowledge "per se" but rather a combination of declarative, procedural and conditional knowledge built through reflection on the objectivation of experience "(Martineau, 1999: 33)

We have just seen a definition of declarative, procedural and conditional knowledge. All of them are involved in the development and mobilization of competencies as well as the way in which they are constructed.

In the development of his competencies, the student must acquire a certain amount of knowledge which he will be able to mobilize into action. The types of knowledge targeted by programs and thus involved in the competencies developed by the students in class determine to a large extent the choice of teaching practices. We do not learn *declarative knowledge*, *procedural knowledge* and *conditional knowledge* in the same way. As types of knowledge they are not represented in the same way in memory. Consequently, they cannot be taught in the same way nor be based on the same teaching strategies. Each type of knowledge requires a different teaching approach, taking into account its nature and the mental processes involved in its construction.

Document 8

Categories of knowledge



Adaptation by Tardif (1992), *For strategic teaching*, p. 340

Pierre Deshaies (1998)

Document 9

The learning of competencies within the school environment[39]

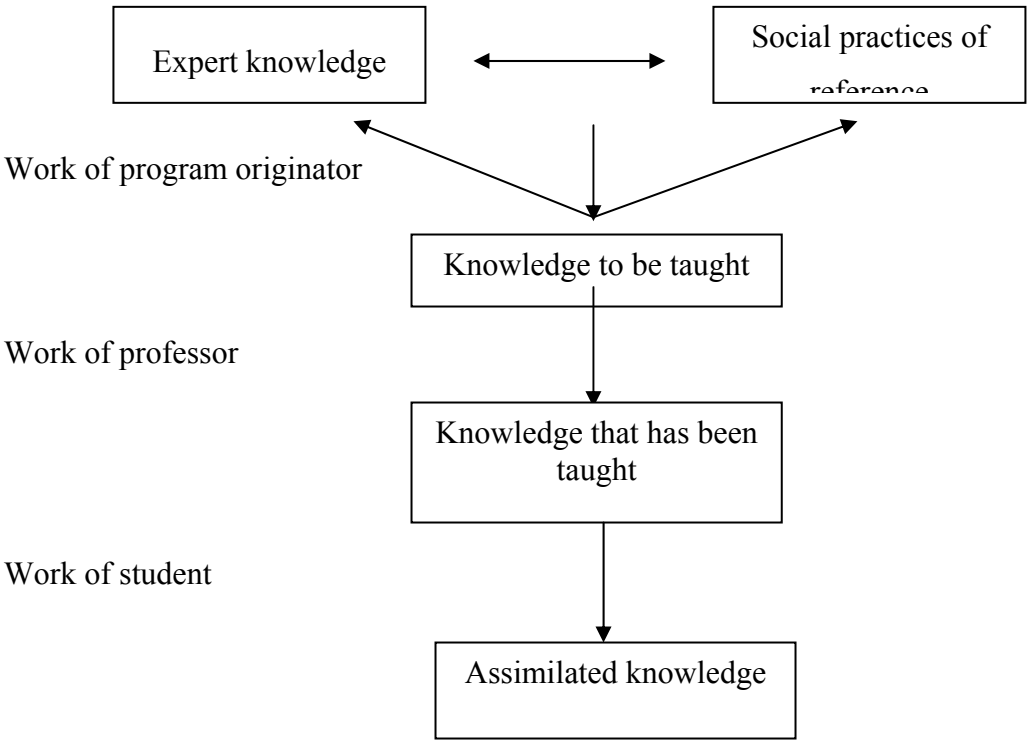
Knowledge transmitted in school is not a carbon copy of scientific knowledge and social or professional practices currently prevalent in a society. As shown in the figure on the next page, what defines the specificity of knowledge learned at school is that it is coded knowledge, i.e. knowledge prescribed in school programs and textbooks. Those who develop these programs determine through deliberation and consensus at various levels, which knowledge should belong in a given program. The student who is placed in contact with coded knowledge (or reference knowledge), must assimilate this learning and transform it into knowledge. So whether it is a question of knowledge, know-how or personal conduct, it falls under a school discipline and recognized professional practice, as is the case for most procedures at collegial level.

The professor must therefore process and analyze if he is to select and organize the information the student will need. He must include this information within the course framework so that the student can master the desired competency.

> "Does this mean there should be a Pythagorean Theorem for science and one for teaching? The professor must experience an epistemological rupture relative to reference knowledge and to his own knowledge if he is to take into account the notions and theories that students have. This does not mean that student notions are scientific knowledge; rather, the errors, concepts and theories are part of the process of knowledge construction. They are the student's cognitive grid for reading the world. And from these notions and theories, the student begins the process of constructing new knowledge. The professor cannot overlook this fact. The notions that students have of the Pythagorean Theorem are therefore key elements in the process of construction of scientific knowledge about the Pythagorean Theorem. These notions are impossible to circumvent and the professor cannot ignore them" (Jonnaert and Vander Borght, 1999: 105)

[39] Raymond, 2001:24-32

A didactic transposition according to Develay (1995, p. 27)



(Martineau, 1999: 26)

In addition, learning at school is necessarily contextualized in a physical and social context particular to the academic environment, which includes:

- a class (students)
- a professor
- a finished action (an objective, a strategy)
- a social environment
- an interactive environment (classroom, timetable, contents: handbooks, programs, resources: tools, tables, material, etc.)
- a physical environment (a time, a particular room, resources, etc).

In this context, learning at school offers a three-dimensional perspective and presents three separate realities:

- The learning subject: a *constructivist* perspective.
  It is the subject himself who constructs his knowledge

- Other students and the professor: a *socio* perspective.
  It is through interactions that learning becomes meaningful and is constructed.

- The educational environment, i.e. learning situations and subject matter organized within these situations: an *interactive* perspective
  The resources and situations encountered contextualize and influence learning.
  (Jonnaert and Vander Borght, 1999: 55)

2.3 What is the nature of learning at collegial level?

> *"The professor is a program adjuster. He unceasingly adapts the content of programs to the unique reality of his students and their knowledge. Programs are written for the "average student' who corresponds to a standard seldom found in our classrooms. The virtual competencies defined in the programs constitute basic material that the professor adapts and modifies according to his classroom realities, while preserving the orientations, major axes and direction of the programs. They cannot be overlooked. These programs map out the course he will travel with his students relative to coded knowledge". (Jonnaert and Vander Borght, p. 50)*

Learning tasks are selected based on the programs in which they will be included and the contents to be transmitted to students enrolled in the courses.

A study program is not:
- A given content that must be stored like an encyclopaedia;
- An organized version of content elements to be transmitted and then recreated as is;
- A handbook itself. If there is a handbook, it is not the program itself.

The study program:
- Is a set of teaching activities;
- Whose goal is to develop disciplinarian and transversal competencies in the student;
- And to provide indications on what to do with the content, the subject matter and also, depending on the situation, why and how to do it;
- And consequently, that leads to didactic implications and serves as a guide on the methodological level.

Programs based on competencies

Since 1994, programs at collegial level are defined according to competencies (competency-based approach). This new model of program elaboration defines education in relation to the development of competencies. This method, in line with the new educational paradigm, invites us to work in a more integrated manner than before. Who can forget the long list of objectives and contents used to describe courses and programs, which made it difficult and even impossible to focus on an integrated goal?

> *"In an approach based on competencies, attention is not focused on contents external to the individual, but on an integration by the individual of knowledge (theoretical and practical), know-how and attitudes needed to accomplish complex tasks which have meaning for the student and are necessary for his adaptation to adult life, in a satisfactory way," (Louis, 1999: 22)*

The competencies selected for programs are now specified by the Ministère in the following sequence: a definition of the competency, the context for its acquisition, specific elements and performance criteria. Also included are academic objectives and the purpose and goal of the program.

A Program Team is mandated to carry out a work of didactic[40] transposition in each college, to fine-tune the program on a local level before its implementation. The professor then receives a course prescription that becomes the frame of reference for competencies targeted by the course, the coded knowledge in the competency and the methodology needed to guide him.

It is important to remember that a course given within a specified time frame does not necessarily contribute to the development of a competency, no more than any competency is fully developed within the weighting of a course. It is reliant on the analysis, organization and didactic transposition done by the Program Team charged with defining the course on a local level. Therefore, in any given course, it is likely we may only develop part of a competency with subsequent courses in the program completing the development of this competency, or a given course may include more than one competency.

The study programs list *virtual competencies*, i.e. targeted competencies that have been standardized as per the work function. However, the competencies of an individual that allow him to carry out an action in the field within a given situation are *effective competencies* and are observed 'a posteriori'.

The professor's work focuses on the axis that leads from virtual to effective competency (a posteriori). This competency is validated by successful actions in actual situations. To work on virtual competencies alone would reduce learning to the transmission of program contents. To work on effective competencies only, would be like working in a vacuum, without reference. However, to go from virtual competency to effective competency is like travelling from one pole to the other. (Jonnaert and Vander Borght, 1999: 52-53)

---

[40] As shown earlier, the didactic transposition allows us to understand and translate expert knowledge and social practices of reference into teaching content, which is what must be taught and learned.

2.3 Yes… but what is a competency?

> *"A competency implies the existence of resources that can be mobilized. It does not merge with these resources but rather adds to them by managing their synergy prior to taking effective action in a complex situation. Competency increases the practical value of mobilized resources, just as a kitchen recipe transforms the ingredients by mixing them in their proper order, blending them into a rich whole that is greater than the individual parts." (Perrenoud, 1997, in Jonnaert and Vander Borght, 1999: 48)*

Literature offers many definitions of competency. All include one or more overlapping aspects that vary in scope and degree of importance.

The global definitions we propose seem sufficiently general yet precise enough to benefit us in our actions and our teaching. We introduce the most helpful ones for teaching and learning, helpful because they facilitate interventions that help students acquire and develop the desired competencies.

The first definition provided by Pôle de L'Est (1996) focuses directly on the context of learning situations that target the development of a competency, whereas the definition of Martinet, Raymond and Gauthier (2000) refers to a professional context[41]. We chose these two definitions for their complementarity within a school-professional continuum.

[41] This definition is intended to describe the components of the professional competencies of professors. Refer to Martinet, M.-A., Raymond, D. and Gauthier, C. (2000). *La formation à l'enseignement. Les orientations. Les compétences professionnelles.* Québec : Ministère de l'éducation, Direction de la formation et de la titularisation du personnel scolaire. Provisional copy for consultation.

Pôle de L'Est (1996) definition

Competency:

- The end result of learning/training
- centered on developing the student's ability,
- in an independent way,
- to identify and effectively solve problems specific to a family of situations
- based on knowledge[42] whether conceptual or procedural[43], that is integrated and relevant

Competency:	
• *End result of learning/training*	In a teaching context, it constitutes the final reference of a learning situation (objective to be reached during the learning, drawing its meaning from the work function, or the capacity to pursue higher learning in a given field, therefore on the threshold of entering one or the other.
• *Centered on developing the student's ability,*	A competency is acquired through practice. It requires time and frequent application by the student himself.
• *In an independent way,*	To be competent implies that the person knows how to identify and use the resources necessary for his personal intervention.
• *To identify and solve*	A competency requires a representation of a problem or a case study and the construction of a procedure and establishment of a strategy to achieve the desired goals.
• *Effectively*	The application of a competency by the student must be effective and produce the expected results and conform to standards.
• *Problems specific to a family of situations*	A competency is always contextualized, always part of a given field of action.
• *Based on knowledge, whether conceptual or procedural, that is integrated and relevant.*	The structured whole integrates several types of knowledge that make up a competency, each one able to be mobilized at the opportune time. The knowledge is relevant and selected on the basis of its usefulness and potential for enabling action in real life.

Let us look at another definition.

Definition by Martinet, Raymond and Gauthier (2000)[44]

[42] A reminder that Pôle de l'Est (1996) whose writings are inspired by cognitivism, does not distinguish between knowledge and know-how.

[43] Pôle de l'Est (1996) recognizes the importance of conditional knowledge in the construction of knowledge. According to Gagné in the initial text on the subject, conditional knowledge is included as a form of procedural knowledge. In an upcoming revision, conditional knowledge will be explained in greater detail so as to distinguish it from others, specifically as concerns its impact on teaching,

Professional competency:

- Is present in a professional context
- Is located along a continuum that goes from simple to complex
- Is based on a set of resources
- Relates to knowing how to mobilize for action in a professional context
- Results in successful, effective, efficient, recurring and immediate ability to act
- Is linked to a specific practice
- Is a project, a never ending opus

Competency:	
• *Is present in a professional context*	Competency is a contextualized action with a set of constraints. A competency is not a skill even though it is composed of skills. A competency in action relates to the knowledge to act. It is broader, vaster and more complex than a skill which is know-how used in a more controlled and artificial context.
• *Is located along a continuum that goes from simple to complex*	Since it is closer to the realities of professional actions, it is more complex than a skill which uses lower-order cognitive skills.
• *Is based on a set of resources*	These resources (cognitive, emotional, and contextual) are mobilized when action is needed and all work for the benefit of the competency. In this sense, competency is neither a skill nor know-how nor an attitude nor even knowledge itself but the sum total of all, as all are essential to the exercising a competency.
• *Relates to knowing how to mobilize for action in a professional context*	A competent person can interpret the needs and constraints of an actual case and identify available resources needed in time and space, to orchestrate them in a relevant and effective way. Competency is the function of a situation that has been successfully resolved.
• *Results in successful, effective, efficient, recurring and immediate ability to act*	Competency is potential action that can only be observed in specific cases/situations; it makes it possible to solve typical problems that relate to a family of situations.

[44] Martinet, M.-A., Raymond, D. et Gauthier, C. (2000). *La formation à l'enseignement. Les orientations. Les compétences professionnelles.* . Québec: Ministère de l'éducation, Direction de la formation et de la titularisation du personnel scolaire. Provisional copy for consultation.

	It manifests itself in actual situations as an immediate and effective performance (achieves its goals and meets standards) that is efficient (carried out quickly and with an economy of means). A good gauge of competency is the successful outcome of a case. It appears repeatedly in many cases and is stable.
2.25.3.1 • *Is linked to a specific Practice*	Competency has a practical function and reaches objectives set by society; it is also defined by its social utility.
2.25.3.2 • *Is a project, a never-ending opus* **2.25.3.3**	Competency is perceived as a personal development that continues beyond school and throughout professional life.

What is the connection between knowledge and competency?

The acquisition of a competency calls for the integration of all forms of knowledge and the ability to transfer this knowledge; sound judgment and the capacity for regulation. Louis (1999) describes competency as a state, an ability to act rather than a specific action. This state is "linked to a conceptual and methodological structure of knowledge and to attitudes and values that allow us to make assessments and carry out actions adapted to a series of varied and complex cases" (Louis, 1999: 22)

He adds that:

> *"competency is the exercise of one's judgment in the choice and the application of knowledge necessary to carry out an action effectively, taking into account the stated problem and the context in which the action takes place. Competency is also the result of mobilization by the student of declarative, procedural and conditional knowledge for the effective accomplishment of actions that impact his environment and his adaptation to adult life "(p. 23) He further states: "the judgment used by the student will therefore rely on the three types of knowledge to accomplish the action and to accomplish it effectively within the context of application" (p. 24)*

Document 10

Principles pursuant to the nature of a competency[45]

Learning takes place gradually in a series of retroactive loops. We could say that humans learn through successive layering i.e., repeatedly experiencing situations within the same learning process. Humans learn by applying a number of principles that have been updated by cognitive sciences and are well-known. *Learning by competencies* supports the organization and application of these principles. Too often, principles of the cognitive-constructivist model are taught and acquired in an isolated way without properly analyzing their practical application to teaching.

The purpose of this text is to organize these principles for the planning of teaching, learning and evaluation activities associated with *Learning by competencies*. This new way of introducing learning principles emphasizes the systemic approach that connects them. Thus, the same activity can introduce several principles and reinforce their integration through systematic interaction. This section also defines the principles of globality, construction, application, integration, iteration, distinction, relevance, alternation, coherence and transfer.

I recommend that the totality of these principles be taken into account for the planning of teaching, learning and evaluation activities, at each sequence in the mastering of a competency.

Globality: analysis of elements based on a global situation (complex case, overall picture, global approach).

The principle of globality refers to the global approach and the use of global tasks (integration and problem situations) to provide a global vision of the learning.

Construction: activation of prior acquisitions, elaboration of new learning, organization of information.

In this principle, it is important to recognize the basic strategies of constructivism:

- activation of acquisitions relating to the contents and the required components
- elaboration of links between prior acquisitions and new learning
- personal organization of information to integrate new acquisitions and consolidate them in long-term memory

[45] Excerpt from LASNIER, François, Réussir la formation par compétences, Guérin, 2000, beginning p.159.

Alternation: global → specific → global
competency → components → competency
integrating task → specific learning activity → integrating task

Globality is important but insufficient for in-depth learning. The principle of alternation i.e., the passage from global to specific and from specific back to global completes the globality. It would be wrong to assume that all this can be accomplished using integrating tasks only. In fact, we must break the totality into parts and then reconstitute the parts into a complete whole. This principle contributes to the reinforcement of integration. It supports a more in-depth comprehension of the competency to be acquired.

Application: To learn by doing.

It is said that competency is the knowledge to act. It is a utopian belief to think that competency can be acquired without action-centered learning. In the past, educators were preoccupied with students acquiring declarative knowledge. Now, not only must students acquire this essential knowledge but professors must also take care to teach them what to do with this knowledge.

Distinction: Content versus process.

When it comes to learning by competencies, a competency cannot be activated in a vacuum. Therefore the student needs disciplinarian content to activate the components of the competency. However, since students use the components of a competency to master disciplinarian content, it is likely that they will lose sight of the process which they must also master. The distinction between content and process is largely instrumental in acquiring the components of the competency, as well as suitable learning strategies.

Meaning: Meaningful and motivating cases for the student.

This principle contributes to *globality*. It establishes links to an actual case (labour market, life at school, everyday life, life's experience). It also identifies the types of tasks related to mastery of the competency, everyday life and school tasks. In this instance, competency is considered a "tool" that is used to accomplish a family of tasks.

At the beginning of the learning sequence, the professor can take advantage of this to "open the door to transfers". However, it is not a question of implementing the *transfer* process at this stage but rather of identifying *transfer targets* for future reference.

In exploiting this principle, we call on the student's motivation to stimulate his learning. The student is made to recognize that he is the principal player in his own learning. And whenever possible, the professor should have students participate in the selection and planning of learning tasks.

Coherence: the coherent relation between teaching activities, learning activities, evaluation activities and competency.

Both the learner and the professor must be able to clearly see the connection between teaching activities, learning activities and evaluation activities that are necessary in the acquisition of a competency.

A key strategy in ensuring that learning activities are understood is the identification of the competency components. Moreover, the principle of **coherence** is often activated simultaneously with *application*. Therefore, the professor and students recognize that to properly learn a concept, it must be applied to a concrete learning activity.

Integration: the elements under study are connected to each other and to the competency. The learner masters the competency by using the components in an integrated way.

The principle *of integration* is the basis for competency-centered learning. A person may adequately master a component of the competency when it is used singly, but be unable to apply it when it is coupled with another component in a more complex case.

As concerns integration and the explicit teaching of procedural knowledge mentioned earlier, we must consider a competency as procedural mega-knowledge. As such, the same learning and teaching strategies for learning a competency should be used. These strategies are numerous. However, it is important to recall traditional strategies for the acquisition of procedural knowledge:

- to identify the stages of the procedure
- to explain the nature of the connection between the stages (components);
- to schematize the stages of the procedure and their interrelationships (integrating diagram of the competency);
- to carry out a task that requires all the stages of the procedure (tasks that require all the components of the competency);
- to objectify what has been done and how it was done relative to each stage (metacognition on the components of the competency and the learning strategies used to accomplish the learning task).

Iteration: The learner repeatedly uses similar types of integrating tasks connected to the competency and the same disciplinarian content.

Learning does not take place at a specific moment in time. It is gradual and we learn through successive layering and in a spiral, by being repeatedly placed in situations (like the multiple layers of an onion) relative to the learning. We often speak of in-depth data processing and we also speak of in-depth learning (layers of learning that lead to integration). When a learner is initially subjected to new learning "successive iteration adds to the learning: relative to the disciplinarian content, to a

greater understanding of the components of competency. The principle *of iteration* thus applies both to the disciplinarian content and the surface-learning of a competency". We should not be surprised to see that students often do not understand a concept during the initial learning activity and cannot practice a skill that is only used once. This does not refer to "exercising" i.e., the mechanical repetition of similar exercises relating to the same subject. To be effective, iteration must be associated with a conscious process and a mobilization of metacognitive strategies. Iteration must be taken in its mathematical sense whereby each one brings an addition to learning: in relation to the disciplinarian content or for greater understanding of competency components. The principle *of iteration* thus applies equally to disciplinarian contents and competencies**.**

Transfer: transfer from a source task to a target task. The application of knowledge and abilities learned in one context to a different context.

Document 11

Current thought in teaching circles is largely based on research, studies and beliefs relating to a number of disciplines including psychology, sociology, epistemology and philosophy. It is important to understand that the various movements (cognitive psychology, sociocognitive psychology, constructivism, socioconstructivism) resulting from these disciplines have led the educational environment to conceive pedagogical models based on a learning paradigm as opposed to a teaching paradigm. The following text summarizes the two paradigms.

From a teaching paradigm…to a learning paradigm[46]

1. The teaching paradigm

Within a teaching paradigm, learning is subordinated to the teaching itself, that is to say that students learn because they are the recipients of teaching and it is the quality of the teaching that determines the quality of the learning.
From this perspective, the focus is on the teaching processes rather than learning processes and on the observable products and demonstrations of learning rather than on thinking and reasoning that underlie the former. This notion, inherited mainly from behaviourist learning theories and mastery learning in particular, stresses the a priori determination of objectives that correspond to the concept of knowledge – whether attitudes, skills or knowledge – that we teach students; and, the elaboration of evaluation processes to determine with precision if the learning was effective.

In short, we tend to establish a univocal correspondence between what is evaluated and what is learned, between what is learned and what is taught. Therefore teaching, learning and evaluation correspond to three very distinct items in a linear sequence; the student can learn only if he is taught and evaluations can only monitor what was taught! This is the perspective of programs centered on objectives, objectives that are usually numerous and fragmented as they correspond to the knowledge and skills which must be taught, learned and then evaluated.

One of the unusual effects of these programs is that they subject both learning and teaching to evaluation: we tend to teach what is easy to evaluate; students are encouraged to learn what will be evaluated! This leads to the development of evaluations that are undoubtedly appropriate for linear and atomized learning, but prove to be inadequate when it comes to evaluating global learning that is constructed by progressive reorganization of prior acquisitions and not by simple accumulation of knowledge; this is the case for competencies.

[46] Translated from LEGENDRE, Anne-Marie, Favoriser l'émergence de changements en matière d'évaluation des apprentissages, Vie pédagogique 120, September-October, 2001, p. 15-19

2. The learning paradigm

Within the framework of a learning paradigm, teaching does not determine but primarily directs and supports learning. The student does not learn because he is taught. A considerable amount of learning takes place independently of any external teaching. Many an excellent professor has students who did not learn (Saint-Onge, 1992a). It is not possible to establish a univocal communication between what is taught and what is learned, since learning does not begin nor end with teaching. So it is not possible to evaluate with perfect accuracy what was really learned. During an evaluation, the student often calls on other knowledge than what he was taught (Legendre, 1998).

In short, students do not learn because they are taught. They learn because learning is a complex process; it is cognitive, social and emotional in nature. It requires teaching practices with processes that are adapted to its nature.

Such a paradigm leads us to consider evaluation as an integral part of the learning process. Its main function is not to sanction success or failure, but to support the student's learning process; it also directs and orients interventions by the professor. Evaluation also implies differentiated instruction, i.e. the ability to implement varied teaching and learning methods that take into account student diversity and allow them to use different routes to progress towards their educational success (CSE, 1993).

This coincides with the perspective of competency-centered programs. It is an approach that does not believe knowledge should be acquired in a compartmentalized and de-contextualized way. Rather, learning is in the interaction and relationship to contexts which give meaning to the learning. It also calls upon the knowledge of the professor to select teaching strategies adapted to the learning, particular traits of the students and the context.

Teaching, learning and evaluation are not considered sequentially as precise moments in time during the teaching process; rather, they are the dynamic interaction within this process. It is not necessary to devise evaluation situations separate from learning situations. Evaluations become an integral part of an approach that incorporates many opportunities for (self-) regulation of learning and teaching activities.

Document 12

Consensus on the new learning paradigm[47]

The responsibilities of professors
1. The activities used by professors to promote learning are not neutral and frequently contribute directly to the degree of student engagement (motivation) and learning accomplished. Professors strongly influence the quantity and quality of student learning.
2. Professors exert a great influence on learning and the study strategies of the students. - Surface learning or in-depth learning? The answer depends on evaluation practices used. For example, by using "true or false" and multiple choices tests, we can lead the student to acknowledge that what he really needs to learn is recognition, even when working with case studies and problem-solving situations, which are learning formulas that favour in-depth understanding. Evaluations on the basis of a portfolios or case studies would be more appropriate in this approach. As a result, there is coherence between teaching and evaluation practices.
3. The ability to transfer learning is what makes it operative, useful and effective. - Professors must intervene frequently in a systematic and consistent way so learning acquired in school can be transferred to outside environments. - The transfer of learning occurs when interventions by the professors are focused on this transferability of knowledge.

The cognitive and emotional dynamics of learning
4. Learning is primarily a personal construction resulting from an active process in which students make their own selections.

[47] RAYMOND, D. (2001). Qu'est-ce qu'apprendre? ou Apprendre, oui mais. Sherbrooke: MIPEC, Performa, Université de Sherbrooke, pp. 36-41

Personal construction:
Consequently, in carrying out evaluations, professors should introduce cases that require more than the ability to recognize statements or accurately recall information.

Active engagement:
Engagement is necessary both on a cognitive and emotional level, without dissociating their respective components, because it is necessary to accept not knowing something and to tolerate doubt and ambiguity in order the search for higher comprehension or mastery.

5. The personal construction of knowledge is founded on the learner's prior knowledge.

Prior knowledge acts as a data processing filter which determines the degree of credibility allotted to any new information. This filter can lead to knowledge being stored for the sole purpose of being used for the summative evaluation. It will then become inoperative or simply get rejected.

Acknowledging prior knowledge has beneficial effects on emotional components:

- Recognition of prior learning leads to a more objective perception of the evolution of personal competency. This self-awareness makes it possible to do away with the negative perception that the learning task "is just like all the rest".

6. Learning always refers back to the context where it was initially acquired.

Students build knowledge based on the logic of their prior knowledge, using a given context or a reference to a particular context for support. The construction of knowledge is strongly contextualized and non-dissociated from the context itself. Without precise intervention from the professor, the knowledge "is not exported" to a different context (example: a course in another discipline).

Therefore there is a need for precise and organized support:

1. *contextualization*
   Make sure that the first stage of learning is contextualized (refer to concrete situations or specific phenomena).
2. *re-contextualization*
   Re-contextualize knowledge (put the students in contact with new cases where the knowledge is re-used).
3. *de-contextualization*
   Give students the opportunity to see their acquired knowledge, observe it, and discuss it outside of any context, yet paradoxically in reference to different contexts. This is to extract the constants and characteristics via different notions and by stressing the necessary and suitable conditions that make it possible to distinguish them from each other.

7. Learning is meaningful because:

- It challenges the student (it is a stimulating yet surmountable challenge)
- It is the result of a cognitive conflict (insofar as we need an answer to our questions; those we ask ourselves and those we ask others)
- It creates a new standpoint (the answers provided cause the knowledge to be reorganized or we actively search for unexplored paths to reach the desired standpoint)
- It is viable for comprehension and action outside of school (if it makes it possible to understand phenomena found in "real life" and develop a higher degree of mastery in our action)

These elements cannot be overlooked since they all contribute to the overall meaning of the proposed learning.

The probabilities of judicious re-use of prior knowledge
8. Knowledge is all the more functionally reusable when organized hierarchically in memory. Organization gives access to knowledge and allows it to be re-used at the opportune time.
9. Knowledge is more functionally reusable when: - It is placed in relation to cognitive strategies **(**planned and coordinated operations that allow for the achievement of cognitive operations, supported by professor support - they increase the probability that the students will re-use their knowledge judiciously provided that knowledge and strategies are closely connected. - It is managed by metacognitive strategies (they manage and regulate cognitive operations as well as control the emotional factors connected to these operations - they intervene to gauge the accuracy of selected strategies and the knowledge favoured by the students in a given context or problem situation).

2.25.3.3.1.1.1 Regarding the consensus, Tardif (1998) also identifies consequences to our pedagogical practices regarding the construction of knowledge. They impact us on three levels: 1) consequences for the characteristics of pedagogical contexts; 2) consequences for planning teaching activities; 3) and, consequences for the support given to learning. These consequences are as follows.

Pedagogical practices relating to the construction of knowledge

On the characteristics of pedagogical context that fulfill the consensual conclusions

1. **They favour complexity: they proceed from complexity to simplicity (creative scenarios, projects to be realized, case analysis, problem resolution):**

    - decomplexification followed by construction towards complexity.

2. **They are competency-centered, i.e. they favour the axis where knowledge is at the service of competencies and are strongly contextualized within the competencies.**

3. **They create the maximum of relationships between the disciplines (interdisciplinary awareness).**

    The logic of the profession or the logic of the program prevails over the logic of the individual discipline**.**

4. **They constantly place theory and action in interaction.**

    Theory leads to a better action plan and action guarantees the contextualization of theory that leads to adjustments relative to the use of knowledge as a tool.

5. **They are attentive to the relevance of evaluation practices.**

    To seek a high degree of coherence as regards the end results of evaluations in a context centered basically on the construction of knowledge and the development of competencies:
    - the primary goal consists in determining the cognitive and socioaffective changes occurring in the student and highlighting their value.

6. **They systematically schedule times reserved for the transfer of learning.**

    To schedule re-contextualization periods; competencies are always capable of further development and re-contextualization increases the level of student mastery for implementing the knowledge and competencies.

Regarding the planning of teaching activities

1. The time needed to teach

- To structure methods so students can build knowledge and develop the desired competencies.

- To plan for enrichment and improvement activities.

2. The choice of teaching and learning activities

In certain teaching fields, learning with problem cases or projects constitutes the most judicious choice; in others, it is creative activities, concept development and remediation.

To grant special attention to the methods of evaluating learning because they exert enormous pressure on the learning and study strategies selected by the students.

3. Planning how the learning activities will unfold

- To insist on the value of the learning as well as on the perception students have of their competency to achieve the learning in question.

- To specify methods to review the prior knowledge of students and validate it.

- To recognize appropriate times to intervene with students in the hierarchical organization of their knowledge.

- To schedule periods when interventions will be focused on the establishment of precise links between competency and knowledge.

4. Integration periods

- To plan integration periods to allow students to prepare syntheses and get ready for their comprehensive assessment.

- The integration and synthesis periods must be frequent and must gradually follow the cognitive and socioaffective metamorphoses of the students.

Pedagogical practices relative to the construction of knowledge

Regarding support for learning

1. To determine the stages of de-contextualization.

- During this period, students are in contact with information in a raw state and are led to carefully examine specific sections of knowledge.

This de-contextualization must be in constant interaction with the stages of contextualization, de-contextualization and re-contextualization.

- To establish explicit relations between knowledge and competencies, while intervening on the hierarchical organization of knowledge.

2. To lead students to reflect on the cognitive choices they make during the action.

- To require that students develop reflective thinking so that competencies are examined and rest on solid theoretical principles and foundations.

3. To enable the transfer of learning.

- To lead the students to perceive knowledge as a set of tools and resources.

To require that students identify contexts in which they can use the knowledge they are building and the competencies they are developing.

4. To influence the motivation of students, their commitment and persistence in this commitment.

- Active involvement resulting from a cognitive conflict that initiates the search for a new standpoint. It is important to:
  - to make the students conscious of the conflict they are experiencing and ideally bring them to be able to name it;
  - to help them become aware of a new standpoint at the end of the learning in question;
  - to determine explicitly the degree of resolution of the conflict at the outset as well as the state of their knowledge and their competencies seen from within this new perspective.

Document 13

Characteristics of a constructivist learning environment [48]

Stimulating, rich and flexible context

The environment is characterized by trust, respect and interpersonal relationships; it supports risk taking, encourages transparency, communication and support between individuals. It is permeated with culture and develops non-formal learning as well as connections to the environment, thereby creating multiple learning opportunities. With its world view, it offers multiple perspectives that mirror its complexity; and maps the limitations of human knowledge.

Purpose

The environment assists the learner in defining his learning goals. It allows him to see the value of his learning and its resulting actions. He can also orient the selection as well as the processing of data.

Active involvement

The learner is actively involved in work for which he has helped define the theme, the objectives and the strategies for achievement. The environment favours direct experience that requires the implementation of the learning strategy appropriate for the situation. The learner manipulates objects and tools to reach his objectives and devises original solutions. In doing so he participates in the construction of new knowledge. He is responsible for the results achieved and the constructed knowledge.

Construction of knowledge

Learning is an adaptive activity that allows the learner to apprehend new cases by establishing links to his prior knowledge and between concepts, skills, people and experiences. The environment introduces various situations that force the learner to redefine and rebuild his knowledge. He works actively towards the organization of this knowledge and the identification of the contexts to which they are connected.

---

[48] Translated from: © Robert David, 2001, http://rd.cyberscol.qc.ca/a01/edmonton/Caracteristiques-v3.pdf. (Site consulted on March 22, 2002)

Social interactions

There are numerous social interactions between students, school personnel, parents and the community. The environment encourages the learners to make their knowledge public, to evaluate and debate it. Social interactions make it possible to observe the work of others and also contribute to modeling. They promote support between individuals. Conversation and collaboration multiply the prospects for the resolution of a problem and allow for the introduction of complex projects which can impact beyond the school environment.

Real and stimulating cases

Learning situations present real challenges that are linked to the reality of the students and which can have an impact on this reality. They cause a cognitive imbalance and call into question erroneous notions. These cases convey an idea of the complexity and variability of reality and not an idea of a simple and stable world. They provide tools to highlight the multiple perspectives and the limitations of knowledge. They are numerous and strongly contextualized to allow the learner to experiment and, ultimately, to support the transfer.

Feedback and support

Feedback must be frequent and manifold. It comes from the learning situation, peers, school personnel and the environment. It provides encouragement to support commitment and helps to increase the quality and effectiveness of the learning actions and process. In this context, evaluation serves to support self-analysis with the professor as a guide who intervenes to assist the learner in his organization of knowledge. The professor seeks to develop independence so the learner can apply by himself suitable knowledge and competencies in a variety of contexts.

Critical thinking

The learner casts a critical eye on his thinking and that of others. He evaluates the objectives, the stakes, resources and resolution strategies, the approach and the answers they provide. He uses his natural reasoning process to support a transfer of knowledge and manages his learning in a metacognitive way.

Document 14

Abstract of current theories on new approaches [49]

There are several key elements to remember when using a constructivist approach to teach. First and foremost, it should be understood that constructivist thinking is not a series of recipes. Since Vygotsky elaborated on the constructivist theory, all subsequent elaborations continue to share the same belief, i.e. that learning is not an act whereby knowledge is transferred, but rather a process in which each individual constructs his own knowledge and develops his own competencies based on his own experience.

Researchers on the subject believe that what takes place in the classroom should reflect what takes place in real life. We do well to remember that knowledge and competency are individual and do not necessarily conform to the conventional wisdom of a community or society. An individual's experiences can lead him to interpret reality in a very different way, based on his needs, his thoughts and prior knowledge. However in general, when he confronts his own knowledge, theories, ideas, etc, with knowledge that society recognizes as being true, he is led to adjust his ideas so they comply with conventional knowledge. This being said and taking into account what is known about learning and cognition, a professor who wants to implement a constructivist approach should initially reflect on learning and become familiar with current learning theories in the field of education.

In rudimentary fashion and discounting the orientations and nuances described in research, we can list several important aspects of constructivist thinking. To wit, researchers and thinkers:

1. Base their beliefs on the concept that each individual constructs and adjusts his knowledge and his competencies according to his experiences;

2. Believe that learning is initially a reflection and that education must be centered on creating conditions and introducing situations that stimulate reflection in students;

3. Believe that any learner in a process of constructing knowledge is in a zone of proximal development that is between what he can do alone and what he can achieve with assistance. The assistance he gets helps to shore up this knowledge;

4. Believe that every individual forges his own concepts of reality based on what he thinks, supposes and knows when he is faced with new experiences which he needs to understand; thus the importance of exploring preconceptions and prior knowledge in the construction of knowledge;

5. Believe that each individual transforms information and new experiences into knowledge by a process called interiorization;

6. Believe that each individual develops his own cognitive models and modifies them as he organizes his new knowledge;

---

[49] Translated from Liste des Post-its, http://www.tact.fse.ulaval.ca/fr/html/cours/coursgcr/post/postit23.htm

7. Affirm that there is a social dimension to learning and that language (communication, collaboration, exchanges, clash of ideas, inquiries, etc.) is an essential component of knowledge construction. It is this social dimension of knowledge that underlies the concept of socioconstructivism and from which originates cooperative learning or learning in collaboration;

8. Reiterate that learning takes place in complex situations containing all kinds of knowledge and processes. It does not occur when knowledge and competencies are divided and parceled into separate disciplines. Researchers employ the expression "situational learning" to describe a pedagogy that respects this reality;

9. Affirm that computers are tools that transform the classroom into a place of learning with the same possibilities as real life (expert consultation, research, communication with the outside world, exposure of products to a clientele outside the school, etc.);

10. Believe that computers in school and in the classroom transform the environment into a learning community where students rediscover their capacity to build their own knowledge and collaborate among each other; where professors assumes their rightful roles of mediator and guide; and, where the classroom is open to the outside world by means of the Internet and e-mail (expert consultation, access to a vast library of documentation, product manufacturing, product exposure on Web sites, etc.);

11. Believe that the learner constructs knowledge when he himself is motivated to set goals, find solutions to complex problems and questions, design or manufacture a product; in summary, when the learning activity has meaning for the learner;

12. Recommend the *Project* and *Problem solving* as strategies for complex learning situations;

13. Believe that traditional schooling, by insisting on the evaluation of knowledge rather than on its construction, repress the learner's desire to learn and willingness to take risks;

14. Believe that the learner gets his motivation from learning tasks in which he is actively involved;

15. Believe that schooling must develop the construction of competencies in addition to the construction of knowledge because our society demands the ability to communicate, interact on a human level, solve complex problems and make decisions relative to our role within it; in short, to build viable and transferable knowledge;

16. Affirm that each individual has eight forms of intelligence and uses some more effectively than others, although he is capable of developing each form.

Plenty of food for thought for concerned readers!

Constructivist principles[50]

1. Constructivist professors welcome and encourage student autonomy and initiative.

2. Constructivist professors use raw data and primary sources along with manipulative, interactive, and physical material. Constructivism presents raw phenomena and initiates students into describing their differences, encourages them to analyze, synthesize and evaluate. Learning is a result related to real problems.

3. While framing tasks, constructivist professors use cognitive terminology such as classify, analyze, predict, and create.

4. Constructivist teachers allow student responses to drive lessons, shift instructional strategies, and alter content along the way if the need for such an adjustment is felt.

5. A constructivist professor introduces problems perceived as relevant for the students and, if need be, makes them relevant via mediation. Otherwise he abandons them (the assumptions are verifiable, they are neither too difficult nor too easy to solve, their resolution requires the participation of the entire group).

6. Constructivist teachers engage students in experiences that might engender contradictions to their initial hypotheses, and then encourage discussion.

7. A constructivist professor attaches a great deal of importance to questions and answers:
   - He encourages the students to ask questions, to make assumptions;
   - He allows students time to ask questions and express their viewpoint
   - He avoids judging an answer but if there is an error, he helps the student become aware of it;
   - He seeks to have students enrich the answers they provide;
   - He encourages students to ask each other questions, to dialogue, to initiate discussions;
   - He uses answers given to re-launch discussions;
   - He encourages student questions by asking thoughtful, open-ended questions that are more global than specific in nature.

8. A constructivist professor provides time for students to construct relationships and create metaphors.

9. A constructivist professor helps students determine relationships between studies so as to identify similarities and differences.

10. A constructivist professor nurtures the natural curiosity of students.

[50] http://www.tact.fse.ulaval.ca/fr/html/cours/coursgcr/textes/capsule3.htm

Document 15
Learning and teaching strategies

Learning strategies[51]: Cognitive strategies	
Strategy	**Actions**
2.26 Activation (for declarative and procedural knowledge)	- I remember what I know about a subject. - I remember how I carry out this type of task (stages). - I remember other cases where I carried out similar tasks.
Acquisition (for declarative knowledge) (surface treatment)	- I repeat silently or out loud what I want to learn (simple repetition: a, b, c; cumulative repetition: a, ab, abc). - I remember by linking two ideas together (Québec, capital of the province of Québec). - When I read, I underline or highlight the important parts. - When I listen to the professor, I take notes.
Elaboration (for declarative knowledge) (in-depth treatment)	- I write down key words which summarize what I want to learn. - When I read or listen, I recap the main ideas in my own words. - I ask myself the question "What do I want to learn?" - I associate words with an image. - I establish links between what I already know and what I want to learn. - I say and write examples and counterexamples to explain what I learn. - I ask myself questions or I ask questions to others.

[51]Translated from LASNIER, François (2000), *Réussir la formation par compétences*, Montréal, Guérin, pp. 421 to 432.

Learning strategies: Cognitive strategies	
Strategy	**Actions**
Integration (for procedural knowledge: proceduralization + composition)	- I name or write down the procedure (elements of the competency). - I schematize the stages of the process (arrange the elements of the competency). - I carry out tasks which activate all the stages of the process (elements of the competency). - When I carry out a task, I establish the link between the stages of the task and the stages of the process (specific references to the elements of the competency). - When I know the process well, I put my own personal stamp on it.
Transfer (for procedural and conditional knowledge)	- I analyze the nature of the source task (disciplinarian knowledge, competencies, and context). - I analyze the nature of the task to be carried out (target task) (disciplinarian knowledge, competencies, and context). - I determine the similarities and differences between the two tasks (if there are few differences, then the process is not a transfer but integration). - I identify the new knowledge that I must learn and the skills I must acquire or adapt. - I carry out the new task by adapting and completing my learning.

Learning strategies: Emotional strategies	
Strategy	**Actions**
Reception	- I agree to receive information on a given subject. - I agree to try and accomplish a task, even though I do not know how to do it yet. - I adopt a positive attitude relative to the task.
Motivation	- I identify the reasons that make it important for me to invest effort into carrying out the task. - I identify the reasons that de-motivate me and cause me not to invest time and effort in the task. - I evaluate my chances of success: Is the task too easy? Too difficult? - I participate actively in the task. - I invest time and effort into my work. - I do not worry about being able to properly carry out my task. - I remind myself how proud I will be when I succeed at the task. - I realize that this task will be useful to me in future tasks.
Management of anxiety (stress)	- I evaluate my degree of anxiety (neither too much nor too little). - I concentrate on my chances of success and not on failure. - I ask for details on the goals and the instructions of the task. - I ask for assistance if I am stressed. - I breathe slowly and deeply. - I undertake an activity to help me relax. - I think of past successes.

Learning strategies: Emotional strategies	
Strategy	**Actions**
Cooperation	- I am tolerant of others. - I collaborate in establishing rules of operation. - I ask for assistance from a team member. - I help a team member in difficulty. - I collaborate in teamwork planning - I accept the role which is assigned to me in the team. - I listen to the viewpoint of others. - I acknowledge the work of other team members.
Resolution of conflict	- I identify the reasons for the conflict and its context. - I identify the consequences of the conflict. - I listen to the viewpoint of others. - I say what I think without blaming others. - I recognize my errors. - I participate in proposing solutions to the conflict. - I choose, in collaboration with others, a solution that suits all. - I agree to make compromises. - I apply the chosen solution. - I evaluate the results of this solution. - I collaborate with others, to adjust the solution if need be.

Learning strategies: Management strategies	
Strategy	**Actions**
Time	- I use a diary. - I identify the time needed for each stage of the task. - I try to save time. - I make time for my school work. - I plan rest and leisure periods for myself. - I avoid procrastination, doing work at the last minute. - I respect the timetable. - If I have too much work, I prioritize.
Material resources	- I make sure I have all the documents and tools I need. - I identify all the documents and tools I need before beginning a task.
Human resources	- I identify peers who can help me if I experience problems. - Before beginning a task, I ask myself whether I will be working alone or with others.
Environment	- I work in a comfortable environment so I don't tire out unnecessarily. - I know where my books and school material are kept. - At home, I work in a restful and quiet area.

Learning strategies: Metacognitive strategies	
Strategy	**Actions**
Activity planning	- I ask myself what are the ways in which I like to learn. - I ask myself at what times my learning is most effective. - I identify the nature of the task to do (instructions, expected results, success criteria, intentions and goals, timeframe). - I identify the nature of the learning (disciplinarian content, competencies, strategies). - I include competencies and strategies required by the task (cognitive, metacognitive, emotional and management) in my activity toolbox.
Verification (of conditional knowledge)	- I ask myself whether I am using the appropriate expertise and strategies (cognitive, metacognitive, emotional and management). - I ask myself whether I am using my expertise and strategies appropriately. - I ask myself if I am currently working effectively. - I concentrate on the task I want to carry out.
Regulation and evaluation	- I identify the strategies and the expertise I used in the task. - I give an account of the approach I used for the task (what competencies and strategies were used). - I judge whether I worked well or poorly. - I carry out an exercise "in objectivation". • What did I learn? • How did I learn it? • What did I find easy? • What did I find difficult? • What did I like? • What did I dislike? - I carry out an exercise "in self-evaluation". • What did I succeed in doing? • What did I fail in doing? • What are the errors to correct? • What do I do to correct my errors? - I continuously readjust my task goal based on the difficulties and gaps identified in formative evaluations.

Teaching strategies[52]: Professorial strategies	
Strategy	**Actions**
2.27 Oral presentation	I present a summary of my presentation. I use visual aids. I organize my ideas in a clear and precise way. I react to the audience. I encourage students to ask questions. I limit myself to fifteen minutes; I punctuate my presentation with learning activities in which the students are active (a few minutes only with young students). I position the presentation in relation to the learning of the student. I plan a learning activity that facilitates the acquisition of the presentation content. I use my expertise to "communicate" in the classroom.
Practical demonstration	I demonstrate clearly (at varying tempos) how to carry out an action or operate an apparatus. I make sure that all the students can see the demonstration clearly. I use auditory support. I encourage students to ask questions. I plan learning activities that allow students to practice the action or the application.

[52]Taken from LASNIER, François (2000), *Réussir la formation par compétences*, Montréal, Guérin, pp. 405-420

Teaching strategies: Individual work strategies	
Strategy	**Actions**
2.28 Independent practice	I always conduct a “guided practice” activity before conducting an “independent practice” activity. I give clear instructions on expected results. I specify the work objectives. I offer to troubleshoot. I place value on individual effort. I encourage the students, I support their motivation. I ask students to use the transversal competencies to “process data” and exercise their “cognitive capacities”.
Individual work session	I orient the activity toward the activation and elaboration of new learning and the integration of a new set of knowledge. I specify the objectives of the work session. During the activation and elaboration stage, I am not concerned about results. During the "integration" stage, I am very attentive to the results as concerns the product and the process. I ask the students to use the transversal competencies to exercise their “cognitive capacities ".

Teaching strategies: Individual work strategies	
Strategy	**Actions**
2.29 Case study (can also be exploited as an interactive strategy)	I present a case to be studied that is as close as possible to reality and that calls expertise into play. I vary the means I use to present the case (oral, visual, written, simulation). The instructions on expected results are clear and precise. I give students time to study the case. I use this strategy to support learning integration. I question students on their know-how and not on their declarative knowledge.
Problem-based learning	I present a problem that is as close as possible to reality and that calls into play all the elements of a competency. I ask students to use the transversal competencies to help in solving problems". I troubleshoot when necessary. I use this strategy to support learning integration.

Teaching strategies: Interactive strategies	
Strategy	**Actions**
2.30 Discussion group	I introduce the subject and key elements to be discussed. I ask the students to prepare for the discussion (reading, research). I give clear instructions on the objectives of the discussion. I vary the way of setting up the groups (panel, debate, buzz-group, square root, pass-round, plenary session). I accurately estimate the time needed. I ask each group to name a moderator or a secretary. I prepare questions to launch the discussion, if necessary. I ask the students to activate the transversal competencies to "communicate clearly" and "communicate effectively".
Role play	I remind students that role play is to validate their comprehension of a phenomenon and to illustrate their know-how. I ask the students to prepare in advance. I make sure students feel they have freedom in the creation and interpretation of role play. I provide a time limit. I establish links between the elements observed and the learning to be realized. I ask students to use the transversal competency "to exploit their creativity".

Teaching strategies: Interactive strategies	
Strategy	**Actions**
Modeling	I demonstrate the task in front of students so they may clearly understand it. I question my own motivation. I show how I act when I need answers to my questions. I use my capacity for metacognition out loud, i.e. I speak my thoughts as they enter my head. I underline the difficulties that generally occur when carrying out this type of task. I establish the links between my actions and the expertise required.
Guided practice	I show how modeling is done before students participate in a guided practical activity. I regularly question students on their way of doing things. I regularly give feedback to re-direct or correct students. I try to create a climate of mutual assistance and support. I use an “independent” activity to follow up on a guided activity.
Learning step by step (Q&A)	I use this strategy when I am in an "activation-elaboration" mode. I formulate one or more questions at each stage (step) to help students complete each one. I review errors at the end of the stage before beginning the next one. I encourage students to ask their own questions. I vary the type of presentation (oral, written). I show the link between the key stages. I establish links with the capacities of the solicited competency or competencies.

Teaching strategies: Socioconstructivist strategies	
Strategy	**Actions**
Peer teaching	I make sure that students are in a climate of confidence. I make sure that the same student is not always in the role of learner. That even the weaker student plays the role of instructor on occasion. I make sure that the student playing the role of instructor maintains a relationship of support. I regularly check to see if teaching conforms to the learning requirements. Occasionally, I suggest strategies to the student playing the role of instructor. I encourage the student receiving the instruction to assist the "instructor" should the occasion arise.
Tutoring	I make sure that the student receiving the tutoring feels at ease with the tutor. I make sure that the tutor properly understands the behaviours of a 'helpful' relationship. I am available to help the tutor-student should the need arise. Occasionally, I suggest strategies to help the tutor improve his role of instructor.
Teamwork	I ask the students to use the transversal competency "to cooperate". I circulate among teams to assist where it is needed. I make sure that the instructions for the task are well understood both individually and collectively, if this is the case. If necessary, I help solve conflicts within the teams (I guide students towards the transversal competencies "to solve problems" and "to communicate effectively").

Teaching strategies: Socioconstructivist strategies	
Strategy	**Actions**
Cooperative learning	I guide the students towards the transversal competencies "to communicate effectively" and "to cooperate". I vary the way teams are created (freeform, fixed, homogeneous, and heterogeneous). I form groups of 5 students or less. I regularly review the rules of operation and the expected behaviours with the students (I readjust if necessary). I make sure that the students vary their roles within the team (moderator, secretary, revision, observation, regulation, etc). I gradually initiate students to cooperative learning. I regularly review with the students the principles of "positive interdependence". I regularly review with the students the conditions for the success of "cooperative learning". I vary the cooperative learning tasks (to learn together, to search as a group, learning in teams, etc.). I occasionally verify the level of personal and collective responsibility of each student (using a logbook or observation chart). I discuss classroom management strategies with students (displacements, noise level, ergonomics, organization of material required, etc.).

Teaching strategies: Socioconstructivist strategies	
Strategy	**Actions**
Project based learning (can also be used with the strategy of individual work)	I elaborate, alone or with the help of students, a project that integrates the expertise of several disciplines. I ask the students to use the transversal competencies "to carry out projects" and to exercise their “cognitive capacities ". I vary project types (short, long, individual, and collective). With young students, it is important to avoid long projects. I make sure that the objectives and the instructions for accomplishing the project are well understood. I validate the plan for each project before the students carry it out (I make adjustments with them if necessary). I identify with the students the resources needed for the project. I am available to support (advise) the accomplishment of the projects without interfering with their management. I identify evaluation criteria before beginning the project. For collective projects, I facilitate the organization of information pooling sessions. For collective projects, I ask the students to use the transversal competencies “to work cooperatively".

Acquisition of declarative knowledge (learning)

1. Elaboration

- is used to add information to acquired knowledge;
- tries to multiply the access routes to long-term memory;
- *Strategies*
    - to rewrite a statement in one's own words;
    - to write an abstract of a text.

2. Organization

- divides information into subsets, structures information hierarchically;
- is used for storing information and processing various information at the same time (relative to the amount of information that the working memory can process simultaneously);
- *Strategies*
    - to make a diagram;
    - to request that a diagram be made;
    - to present the knowledge in the form of a model;
    - to find examples, analogies.

Acquisition of procedural knowledge (know -how)

1. Proceduralization

- establishes a sequence of actions that are connected to each other;

- regroups information (series of actions) within the same informational unit to make the working memory more effective (this is the distinction between "expert" and "beginner"). In a beginner, a set of actions might occupy the entire working memory thereby limiting its ability to analyze other important aspects.

- *Strategies*

  - to become aware of actions and their sequence;
  - to establish the process, to explain it in a precise way;
  - to have the student draft the procedures;
  - to refer regularly to the procedures, to use the procedures in a sample case (to identify connections between the stages), to justify the choice of actions;
  - to go through the model production stage (see diagram).

2. Composition

- consists in learning how to connect the actions of a given procedure to each other;
- leads to the application of the procedure to various problems and in various contexts so as to gradually make the procedure second nature;
- can only be acquired by action, also requires correction;
- works at carrying out tasks effectively and economically (in energy and working memory);
- must take into account prior knowledge (that is, acquired knowledge).

- *Strategies*
  - to plan tasks (problem case) that require the application of the procedure from start to finish (and not stages only) (global approach – competency based learning);
  - to carry out guided learning, give continuous feedback;
  - to have the student experience the same procedure several times (not mechanistically but consciously; the goal is the interiorization of the procedure through our capacity for metacognition) (awareness of intellectual processes and the control to put it into action);
  - once the procedure is mastered, allow the students to work independently (however, with support being offered if necessary so the student is not completely on his own).

Acquisition of conditional knowledge (when, why)

This knowledge refers to the use of declarative and procedural knowledge. It is the basis for metacognition. For instance, in competency-based learning, it is possible to activate knowledge but be unable to apply it to the situation, to adapt it to the nature of the task to be accomplished. This knowledge is also fundamental in transferring learning, since it makes it possible to analyze the similarities and the differences between the source task and the target task. In general, authors who have written on this subject identify two stages for the acquisition of conditional knowledge: generalization and discrimination.

1. Generalization

- identifies the situations and conditions in which declarative procedures or knowledge would be effective to accomplish the desired task;
- is acquired when two situations are present at the same time in memory so the learner can compare the conditions of application for both.
- *Strategies*
    - to identify the conditions for application of declarative knowledge and procedural knowledge;
    - to store the conditions of application for a procedure or competency in long-term memory;
    - to regularly verify if the conditions of application in long-term memory are still effective or not;
    - to present examples and counterexamples;
    - to analyze several different cases, for which the use of a procedural knowledge is relevant;
    - to formulate rules that condition the activation of procedural knowledge and declarative knowledge.

2. Discrimination

- adds or removes conditions for applying a procedure.
- *Strategies*
    - to compare two cases for similarities and differences relative to conditions for applying procedural knowledge;
    - to analyze several cases relative to the conditions for applying procedural knowledge;
    - to regularly review the conditions for applying procedural knowledge;
    - to analyze the conditions of use of a procedure based on over-generalization or under-generalization, i.e. to apply the procedure to non-relevant conditions and not to apply the procedure when conditions are relevant;
    - to ask the student to choose strategies from among several, to accomplish a given task;
    - to use modeling and guided learning to teach the student how to choose a specific strategy for carrying out a given task;
    - to do several formative evaluations relative to the identification of conditions for the use of procedural and declarative knowledge.

Document 16
Strategic teaching measures

Teaching measures

Strategic teaching is a model that lists the ten steps in an instructor's tasks[53]. These ten steps are further grouped into three major stages. Each one of the teaching steps includes teaching measures that the instructor is likely to implement at each stage.

STAGE I: PREPARATION FOR LEARNING

Goal: Give meaning to what is requested of the student.

STEP 1: Discussion on the task objectives

M1 The professor defines the nature of the task.
M2 He indicates the specific learning objectives connected to this task.
M3 He defines the criteria used to evaluate the student's performance, from an operational perspective.

STEP 2: Overview of the material

M4 The professor familiarizes the student with the organization of the material that is placed at his disposal.
M5 He distinguishes what is important from what is less important in the material provided.
M6 He provides the organization models for the task.

STEP 3: Activation of prior knowledge

M7 The professor calls upon the knowledge available in the student's long-term memory to help tackle new information.
M8 He introduces the prerequisites which support the transfer of knowledge.

STEP 4: Direction and attention of interest

M9 The professor suggests a series of questions on the goal targeted by the task.
M10 He discusses with the students their past successes or failures with this kind of task and he makes sure they use appropriate cognitive and metacognitive strategies.

AUGER, Denis (1996), La formation par projet et l'enseignement stratégique, Collège of Sherbrooke.

[53] The reader can refer to pages 324 to 333 of the book by J. Tardif, *Pour un enseignement stratégique*, Éditions Logiques, 1992, to obtain more detailed information on the meaning of these ten steps.

Strategic teaching measures

STAGE II: PREPARATION OF CONTENTS

- Goal: to ensure the acquisition of knowledge.

STEP 1: Data processing

M11 The professor encourages the student to use his prior knowledge to carry out the task.

M12 He frequently asks questions both on the contents and the form.

M13 He debates with the student the strengths and weaknesses of his strategies.

STEP 2: Integration of knowledge

M14 The professor works closely with the student to identify the key learning of the task just completed.

STEP 3: Assimilation of knowledge

M15 The professor models and directs the orchestration of new information with prior knowledge, taking into account the student's level of independence.

M16 He initiates interaction between students.

Strategic teaching measures

STAGE III: APPLICATION AND TRANSFER OF KNOWLEDGE

- Goal: to apply the new knowledge to real life situations outside the classroom.

STEP 1: Formative and summative learning evaluations

M17 The professor places the student in a context which enables him to be aware of his level of mastery relative to the new knowledge.
M18 He questions the student on the degree of certainty of his knowledge.
M19 After a formative evaluation, he discusses the value of this new knowledge with the student.

STEP 2: Organization of knowledge in diagrams

M20 Together with the student, he structures the declarative, procedural and conditional knowledge that deal with the same reality.

STEP 3: Transfer and extension of knowledge

M21 The professor insists on conditional knowledge (the starting point of a transfer).
M22 He identifies the conditions required at this starting point.
M23 He supports the transfer of knowledge by showing methods of problem solving.

Each of these 23 teaching measures is made up of *actions* which the professor can use for a specific measure; an action is observable in itself whereas this it is not the case for a measure. Therefore, by observing *the actions* we can analyze *the measures* implemented as the professor evolves in his practice: 68 *teaching actions*[54] have been regrouped into these 23 measures.

[54] AUGER, Denis (1996), *La formation par projet et l'enseignement stratégique*, Collège de Sherbrooke.

Document 17

A frame of reference for strategic teaching[55]

The majority of tools placed at the disposal of professors, often possess a major flaw despite their outward value: there is no reference to **a theoretical framework** that underlies the learning and teaching strategy, and little value is given to the principles on which they are based.

Why do we need a theoretical framework? Because conventional and expressed ideas on "how learning takes place" directly impact pedagogical attitudes and interventions in the classroom. This can be seen in the various projects of strategic teaching where it is obvious that it is difficult, even impossible, to implement pedagogical innovations with professors without an **operational model of reference.** This model is used to analyze, modify, adjust and enrich current practices. It also becomes the grid for analyzing teaching effectiveness and even more importantly, provides a concrete model to develop reflexive thinking in the professor who thus improves his capacity for questioning and has a better grasp of the foundation of his pedagogical practices. The ability to teach a student can be defined as the quality of the professor's own ability to learn.

This reference model that facilitates training and coaching by the instructor is based on a theoretical foundation called cognitive psychology. It is a science that clarifies the emotional, social, cognitive and metacognitive bases of typical learning processes. The theoretical bases are formalized through **strategic teaching principles**. In 1991 at CECM, these principles were identified by Mr. Jacques Tardif within the implementation of strategic teaching practices.

Subsequent to this, it became necessary to be more precise relative to the **pedagogical actions** that brought these principles to life in the classroom. How was it possible to implement these principles in the planning process of learning and teaching? Based on the experience of several professors and educational advisers, pedagogical proposals were initially drafted and put to the test. They were readjusted and validated. Finally, the model was finalized within a cooperative project[56] that involved three school boards in the Québec City area. The project involved a systematic and thorough experimentation with a series of pedagogical strategies detailed in the frame of reference. This research-action project involved 25 professors and the moderator was Jocelyne Picard, professor at the Commission scolaire des Belles-Rives. The project was coordinated by Denise Baillargeon, primary education coordinator at the Commission scolaire de La JeuneLorette.

This article is divided into two parts. In the first, we briefly present the **strategic teaching principles**. In the second section, we briefly take **a cognitive glance at the planning of teaching activities and the activation of the three stages of a learning process.** Also present are pedagogical propositions to assist in actualizing these principles in the learning-teaching process.

---

[55] OUELLET, Yolande (1997), *Un cadre de référence en enseignement stratégique*, Vie pédagogique, # 104, September-October, 4-10

[56] TARDIF Jacques, and Yolande OUELLET. "Vers un plus haut degré de professionnalisme: un scénario d'intervention avec des enseignants du primaire et du secondaire ", *Cahier de la recherche en éducation*, Thématique, La pratique, source de recherche et de formation, Université de Sherbrooke, Faculté de l'éducation, Editions de CRP, 1995, p. 57 to 88.

1. Strategic teaching principles

Conclusions drawn from research in cognitive psychology identify six key pedagogical principles that gave birth to differentiated pedagogical practices. They facilitate a critical examination of the effectiveness of teaching on students.

- According to the first principle, learning is an active and constructive process.
- According to the second principle, learning is primarily the establishment of links between new material and prior knowledge.
- According to the third principle, learning relates to procedural and conditional knowledge as much as it does to declarative knowledge or know-how.
- According to the fourth principle, learning requires the constant reorganization of knowledge based on a conceptual model specific to the type of knowledge.
- According to the fifth principle, learning relates as much to cognitive and metacognitive strategies as it does to theoretical knowledge, and the former can be readily built with explicit teaching of the "what, why, how and when" of a strategy using modeling, guided practice, cooperative practice and independent practice.
- According to the sixth principle, motivation is what determines a student's commitment, participation and persistence in his learning at school.

The first principle

Learning is an active and constructive process. It is important to understand that students do not process all the data presented in the same way and on the same footing. Students are selective and disregard a large amount of data discussed in the classroom especially when the material seems of no importance to them.

In addition, students build their knowledge in a personal and progressive way. So professors must create differentiated pedagogical situations and environments that facilitate this construction; they must also mediate and instruct the students in the process of construction. For these reasons, a re-examination of pedagogical actions relative to student learning is done together with an evaluation/validation of the knowledge. This will enable an understanding of why students continue to make the same mistakes.

The first principle also impacts on the emotional level. In cognitive psychology, motivation is seen as a result of the student's school experiences. Consequently, professors can exert a strong influence on the student's degree of motivation by acting on its constituting elements.

2.3 The second principle

Learning is primarily the establishment of links between new material and prior knowledge. A student cannot process data without establishing links with knowledge stored in his long-term memory. Keen attention must be given to the student's prior knowledge, since it filters the new material. All knowledge will go through this filter.

In addition, professors must grasp the mechanisms responsible for the construction of erroneous knowledge and understand why knowledge already stored in long-term memory is so firmly anchored.

The third principle

Learning relates as much to procedural and conditional knowledge as it does to declarative knowledge or know-how. According to one theory in cognitive psychology, knowledge is declarative (what), procedural (how to), or conditional (when and why to use declarative or procedural knowledge). This theory states that there is a synergy in the very structure of these types of knowledge, in their construction and their integration within the same learning task. Thus, a given learning task must be analyzed taking into consideration this interdependence and interrelationship of knowledge types.

This distinction among types of knowledge is capital since according to research results; they are represented and stored differently in long-term memory. In order for learning to be as effective and meaningful as possible, these differentiated models require adapted teaching practices that are differentiated yet closely linked, depending on whether we are dealing with the declarative, procedural or conditional aspect of knowledge. Thus, the architecture of memory and the strong influence of the working memory on learning are two key distinctions in teaching.

The fourth principle

Learning requires the constant reorganization of knowledge. Research in cognitive psychology has clearly shown that experts are able to organize their knowledge in long-term memory. They have created connections between similar knowledge relating to a given reality and these connections allow for quick recall and the quick processing and use of data simultaneously.

In the case of student inertia, professors can see what mechanisms trigger this behaviour and how the reorganization of knowledge is a powerful tool in reducing this inertia; especially given the fact that declarative, procedural and conditional knowledge have their own models in long-term memory. Students will better see and understand the dynamics occurring in the transfer of knowledge and expertise.

The fifth principle

The construction of declarative, procedural and conditional knowledge by the student contributes to the development of cognitive and metacognitive strategies, constitutes the fifth principle**.** Accordingly, learning relates to cognitive and metacognitive strategies as well as to theoretical knowledge. Many observations made in the classroom, regardless of the strategy, reveal that professors do not intervene frequently regarding the student's use of knowledge acquired at school, their strategies for using this knowledge and its possible fields of application.

Professors must recognize the urgent need to implement cognitive strategies for effective and thorough use of procedural and conditional know-how and especially of metacognitive strategies so as to consciously master the process.

In cognitive psychology, the mastery of cognitive and metacognitive strategies (procedural and conditional know-how) is acquired thanks to explicit teaching of these strategies, the what, why, how and when of a strategy based on modeling, guided practice, cooperative practice and autonomous practice.

The sixth principle

The sixth principle relates to the emotional components of learning and the awakening of motivation at school. According to this principle, *motivation is what determines a student's commitment, participation and persistence in his learning.*

In cognitive psychology, motivation like knowledge is presented as a construction by the student based on his school experiences. It is a construction on which professors can have a considerable influence.

Considerable research has shown that emotional variables such as self-image and feeling competent and secure greatly influence behaviour in learning situations. Previous and current school experiences cause emotional reactions associated with self-image. School is the key place where the student constructs his self-image as a learner and where he acquires a feeling of security and self-efficiency relative to his school tasks.

The student's beliefs about his learning capacities are directly related to his failures and successes, and what he believes their cause to be. These beliefs are determining factors in his commitment at school. The motivation of students therefore consists of two main categories: their **concept** of intelligence, the goals established by the school and their **perception** of the value, requirements and "controllability" of the task, i.e. their power over it. These factors are clues for professors to take advantage of so as to arouse student motivation. Particular attention must be given to the perception the students have of their own control over the learning. Here, the professors must provide the students with the cognitive and metacognitive strategies they need to succeed.

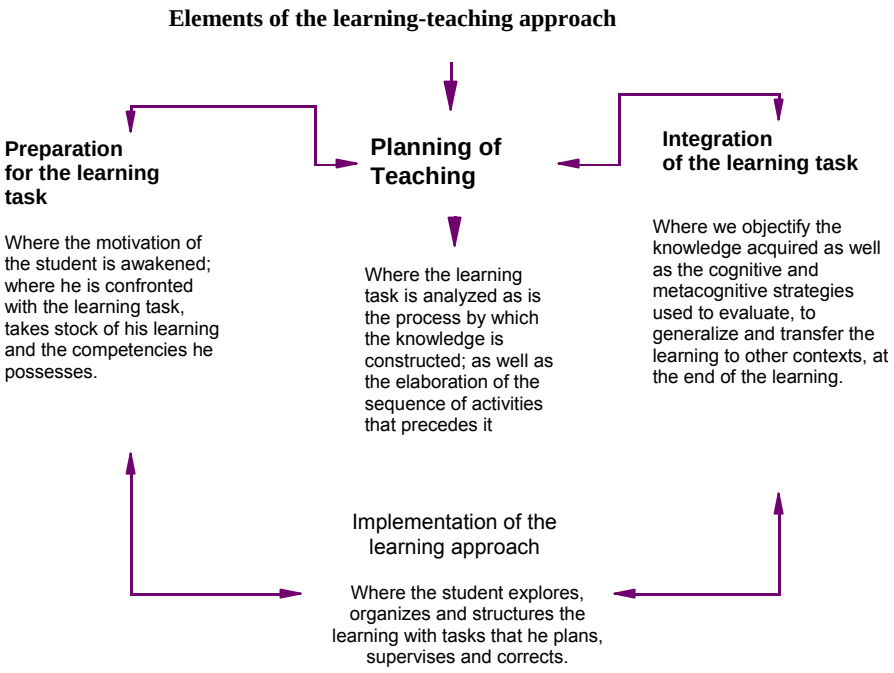
2. A cognitive glance at the planning of teaching activities and the activation of the three stages of a learning process

In this section, we have a double objective. On one hand, we outline **an operational model** that lists and positions teaching strategies that are readily used in the classroom in accordance with strategic teaching principles. In addition, we also present a grid for an **analysis of teaching effectiveness** and a **concrete model** to develop reflexive thinking and the capacity for questioning. All this while recommending experimentation opportunities for further investigation.

This section is divided into two parts.

The first part deals with **pedagogical paths** relative to the planning of teaching activities; the second part concerns pedagogical paths that lead to the activation of the preparation, realization and integration stages of the learning process. We identify teaching measures to be taken in class so as to actualize the planning of activities.

More specifically as concerns the planning of teaching activities and the three stages of learning, we introduce theory and an organizational diagram of the paths.



It goes without saying that the presentation order of pedagogical paths relating to a model is not unchangeable or linear. To account for the action that is being actualized at the heart of a pedagogical process is the blind spot of every model. A learning situation offers a dynamic and systemic dimension that is born and evolves according to the needs of the students, an analysis of the didactic situation and the creativity of the professor. It is up to the latter to judge and dispose of it. These pedagogical paths are elements of reflection on which the professor can rely to analyze various aspects of the learning-teaching process. They must not and cannot be regarded as a recipe to be applied. It is up to the professor to choose the pedagogical paths which are appropriate for the didactic situation being constructed, analyzed and moderated.

2.1 Pedagogical paths for planning teaching activities

This is where analysis of the learning task and the process by which the knowledge is constructed takes place; also the elaboration of the sequence of the activities leading up to the construction.

a) *Theoretical elements*

To consider the learner as the principal actor of the construction of his own knowledge implies an analysis of the knowledge to acquire as well as the structuring of learning situations.

Generally, course planning centered on the transmission of knowledge and “exercisation" is carried out in accordance with the program contents, the basic handbook and the activity or exercise books.

The contents to be taught do not pose a problem in themselves, except for the eternal question of time. What interests the professor, in the words of Jacques Tardif, is "what" to teach, i.e. the contents, and "how" to teach, i.e. the teaching method. The action of the professor and the knowledge presented are at the heart of the process.

The planning of teaching activities that put the learner and the process of knowledge acquisition at the heart of teaching practices raises questions with the traditional approach.

"On the other hand, if the recipient, i.e. the learner is at the heart of the educational action, the problem is of another order: in this case, the conceptual comprehension of the targeted knowledge and the process of elaborating meaning are the focal points. The definition of knowledge to be taught cannot be achieved independently of this comprehension. (Barth, 1994, p. 109)"

In other words, knowledge cannot be examined nor defined independently of the conceptualization process and the ability of the learner. The planning of teaching activities from the "learner's viewpoint" makes it mandatory to consider how the contents are to be learned and the way in which these contents can be processed cognitively by the learner.

The following fundamental questions need to be asked: What characterizes the nature, the organization, the complexity and the interrelationships of the learning task? How does the learner manage to conceptualize this knowledge and know-how? And for which transfer is this knowledge necessary?

The following pedagogical paths provide answers to these questions. The planning of teaching activities, regarded as the base of the learner's cognitive and metacognitive activity, must be centered as much on the learner as on the knowledge and know-how to be taught, so that he becomes conscious of his ability to learn and to transfer acquired knowledge and competencies.

During the planning stage and throughout the learning-teaching process, the professor must be constantly focused on the student's acquisition of the following competencies:

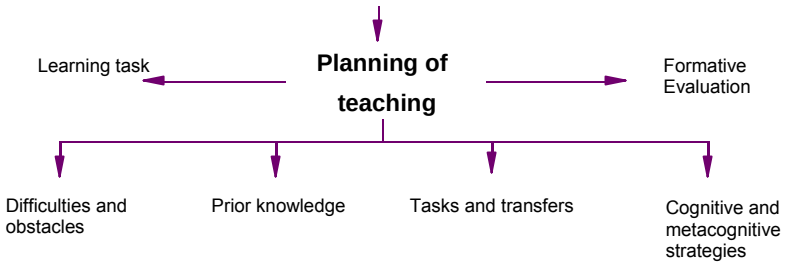
- The ability to organize and structure the declarative, procedural and conditional aspects of the new knowledge into memory, based on prior knowledge;
- The ability to know, manage and consciously self-regulate the learning process;
- The ability to transfer the acquired knowledge and competencies.

Seen from this perspective, the planning of teaching activities becomes a particularly reflexive, conscious, metacognitive activity that is designed so that students can acquire a metacognitive consciousness that supports the "ability to learn how to learn". The planning of teaching activities requires specific professional competencies.

b) *Organizational diagram of pedagogical paths*

Where an analysis is carried out on the subject of learning and the process by which this knowledge is constructed, as well as the elaboration of the sequence of the activities leading to it.

Organizational diagram by pedagogical path



- To define and analyze the types of knowledge relative to the learning task.
- To analyze the difficulties of the learning task.
- To activate prior knowledge and take it into account, before, during and after the learning.
- To structure the activities and the learning situation so as to guide the students in their ability to transfer knowledge.
- To plan for and structure explicit cognitive and metacognitive strategies specific to the learning task in order to transfer the knowledge.
- To plan for interactive formative evaluations as well as formative evaluation feedback tools.

c) *Pedagogical paths*

Define and analyze the types of knowledge relating to the learning task.

- To establish the interrelationship between the learning task and other knowledge of the block, module or program (organizational diagram and conceptual network that positions this knowledge in relation to other knowledge in the field).
- To analyze the degree of complexity and abstraction of the learning task by determining the interrelationship between the types of knowledge attached to it:
  - declarative knowledge;
  - procedural knowledge;
  - conditional knowledge.
- To clarify:
  - the organizational diagram and the semantic network;
  - the sequence of actions;
  - the conditions of use, according to the types of knowledge of the learning task.
- To determine the utility of this learning task, the goal it targets, the field to which it applies and the possible areas of transfer.
- To determine prior knowledge essential to integrating the new knowledge or know-how.
- To plan for the necessary interventions to correct any possible gaps in prior knowledge.
- To identify examples and counter-examples that facilitate the comprehension of the concepts.

Analyze the difficulties of the learning task.

- To analyze the difficulties inherent in the learning task, as well as the erroneous rules students attach to it that hinder learning.
- To plan for interventions with students and for providing support so they may master their difficulties, rebuild rules that are in error and overcome obstacles.

Activate prior knowledge and take it into account, before, during and after learning.

- To anticipate the prior knowledge of students relative to procedural and conditional knowledge and know-how, as well as to the erroneous rules that hinder learning.
- To determine how to bring the students to use and organize their prior knowledge relative to procedural and conditional knowledge and know-how.
- To determine how to intervene with the students based on prior knowledge before, during and after learning.

Structure the activities and moderate the learning situation so as to guide the students in their ability to transfer knowledge.

- To structure learning activities while taking into account the types of knowledge inherent to the learning as well as students' erroneous rules relating to the subject.
- To choose and create learning activities based on the three stages of the learning process: preparation, realization and integration.
- To choose and create complete and complex tasks, differentiated tasks and problem situations that support an effective transfer of the acquired knowledge.
- To analyze the value and requirements of the tasks to carry out and adapt these tasks so that they are meaningful and represent challenges that measure up to the students.
- To choose or create activities which make it possible to contextualize, de-contextualize and re-contextualize the knowledge, in order to bring the students to an explicit awareness of their ability to transfer the knowledge.
- To structure cooperative learning tasks that allow for the social interaction between students and between students and the professor.
- To prepare the required material, the schedules, the classroom organization and the work methods.

Plan for and structure explicit cognitive and metacognitive strategies specific to the learning task in order to transfer knowledge.

- To teach the "what", "why", "how" and "when using modeling, guided, cooperative and independent practices:

- cognitive and metacognitive strategies relative to the elaboration of procedural knowledge, conditional knowledge and know-how;
- cognitive and metacognitive strategies relative to the execution of tasks and the transfer of knowledge.

- To make students aware of :
  - what they learn;
  - how they learn;
  - how they overcome difficulties;

  before, during and after learning, and to express their awareness.

Plan for interactive formative evaluations as well as formative evaluation feedback tools

- To determine the subjects to be covered by formative evaluations during and after learning.
- To schedule time and questions for interactive formative evaluations as well as co-evaluation tasks.
- To prepare formative evaluation feedback tools for student use at end of learning.
- To analyze the congruity of the examination questions and the learning carried out and, if necessary, to adapt the questions.

How do we apply these proposals in the classroom? In the following pages, the proposals are reviewed, supported and actualized in the form of pedagogical actions that make it possible to moderate, orient, guide, direct and support the student in his assimilation of knowledge.

2.2 Pedagogical paths for moderators of the three stages of the learning process

2.2.1 Preparation stage of the learning process

Where the motivation of the student is awakened; where he is confronted with the learning task, takes stock of the knowledge and competencies he possesses.

a) *Theoretical elements*

The preparation stage is important because it determines to a great extent, the quality of the student's commitment. The student needs to know what the stakes are in the learning situation and needs to be reassured as to his abilities to assimilate the learning.

The student's commitment, participation and perseverance throughout the learning process depend on his motivation to learn. This motivation comes primarily from the importance, the value and the challenge the student attaches to the new knowledge. It comes from the need for learning as well as from the feeling of self-efficiency resulting from the upcoming challenge and the anticipated efforts, subsequent to the student's evaluation of his abilities.

If the new knowledge fulfills a need, it arouses interest, attention and a willingness to commit that consequently leads to an emotional and cognitive mobilization of the student. If it does not, then the desire to learn must be awakened. Moreover, awareness that the learning task is connected to previously acquired knowledge and competencies reassures and creates a sense of security essential to any learning. The student interprets, processes and understands the new knowledge, giving it meaning

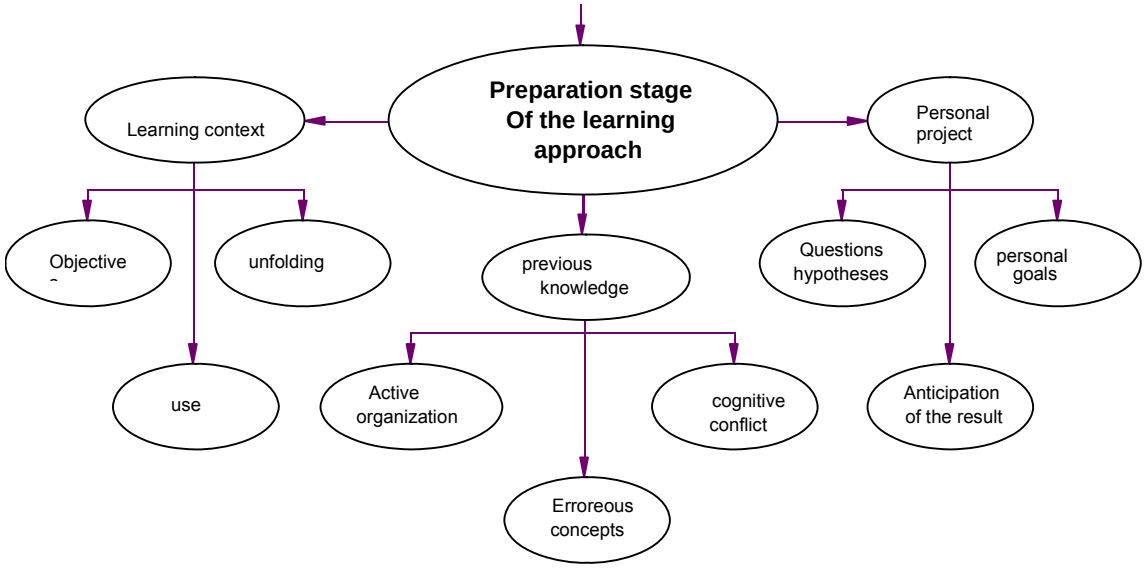
based on his prior knowledge of it. He recognizes the nature and importance of the learning acquired, learns how to recall it and re-use it. Any student who can recall and re-use his acquisitions, establish links with his prior knowledge, discover that the new knowledge and the task are part of a continuum, and anticipate the advantages gained through the acquisition of knowledge reacts positively to the challenge. Such a student sees learning as realistic and confidently embraces the process.

In this section, we will outline pedagogical paths that help students become familiar with the learning context and aware of the control they have over the learning task.

b) *Organizational diagram of pedagogical paths*

Where the motivation of the student is awakened; where he is confronted with the learning task, takes stock of the knowledge and competencies he possesses.

Organizational diagram of pedagogical paths



- To introduce the learning context.
- To use and organize students' prior knowledge of the subject matter.
- To help the students get "involved" in the project, i.e. be totally committed to its completion.

c) *Pedagogical paths*

Introduce the learning context

- Look for triggers to awaken interest and direct the attention of students.
- Introduce the new subject with tables and organizational diagrams showing content; position the subject relative to the overall contents to be covered.
- Find connections with previous learning tasks.
- Demonstrate its usefulness and the scope of the new learning for:
  - continued learning;

- personal, cultural and social education;
- transfers of knowledge to the subject matter, other subjects and everyday situations.

- To define the new learning:
  - the unfolding of the activities and their duration;
  - the preferred work methods;
  - the knowledge that will be acquired ("at the end of the learning task, you will know this, you will be able to do that").

Use and organize the student's prior knowledge of the subject matter

- Facilitate the activation and the organization of students' prior knowledge relative to declarative, procedural and conditional aspects of the learning task.

- Acknowledge prior acquisitions and refer back to them during the new learning situation.

- Identify erroneous concepts and false rules that hinder learning, and guide students in their rebuilding of knowledge.

- Assist students in recognizing the prior knowledge that they validate and transfer.

Help the students get "involved" in the project, i.e. be totally committed to its completion

- Use prior knowledge to provoke cognitive conflicts and the need for learning.

- Ask students to formulate questions and assumptions concerning the new subject.

- Help students understand and anticipate the results of the process.

- Assist students in setting personal goals and defining them in terms of the new learning.

- Be attentive to the quality of the emotional and cognitive commitment of the students throughout.

2.2.2 The realization stage of the learning process

Where the student explores, organizes and structures the learning task with tasks which he plans, supervises and corrects.

a) *Theoretical elements*

The realization stage of the learning process enables the students to interact with the learning task, explore it, confront it with the prior knowledge, organize and structure it in order to build a concept, acquire a skill or competency and carry out a task.

This is the stage where the student actively processes the data to build declarative, procedural and conditional knowledge relative to the learning task. This will be achieved if the professor has created the conditions necessary for this construction and teaches him what to do. Often students are told what to do without explicit instructions showing them how and why to do it. The professor must define the attributes of the concepts, the examples and counter-examples, the organizational diagrams of declarative knowledge, the sequence of actions (the process) for implementing cognitive and metacognitive strategies in the execution of the tasks as well as the conditions of use and transfer of the knowledge and technological know-how acquired. The professor must teach the "why", "how" and "when" to use a strategy of modeling, guided or cooperative or independent practice. Moreover, the professor must select activities, places and times for discussion, dialogue and objectivation to allow students to argue and negotiate the meaning of the learning task and to build a common understanding of it.

Throughout the realization stage, it is up to the professor to facilitate, guide, direct and support the learning process the students must follow. Moreover, the professor must be focused on the thought processes of his students and the process by which knowledge and know-how are conceptualized. To achieve this, the professor must make the student conscious of the way in which he learns and masters the process.

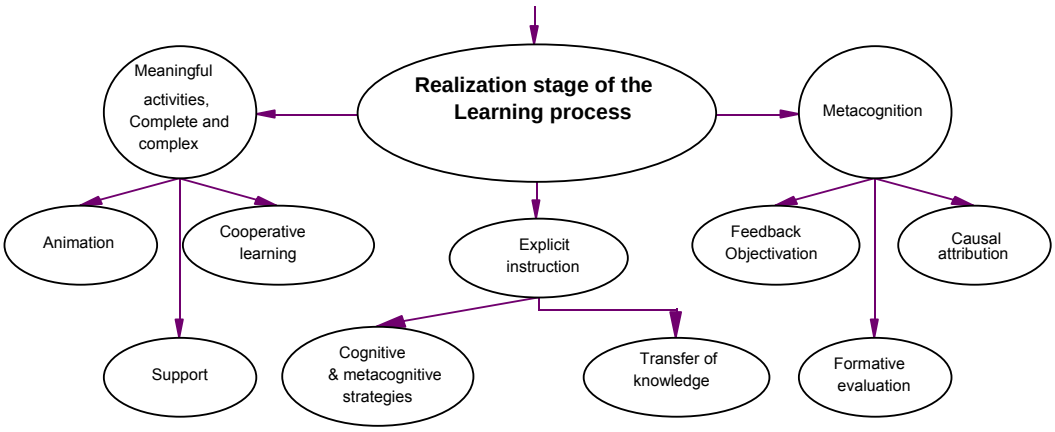
The learning of metacognitive strategies and the ability to transfer acquired knowledge become the object of systematic teaching. The transfer of knowledge requires detailed attention during the realization stage. Transfer of knowledge does not automatically occur at the end of learning nor is it related only to the autonomy of the student. The student must learn to transfer his knowledge; the professor shows him how and makes him aware of the conditions and strategies necessary for the actualization of this competency.

The teaching practices which follow are essential to the development of this ability.

b) The organizational diagram of pedagogical paths

Where the student explores, organizes and structures the learning task with tasks which he plans, supervises and corrects.

Organizational diagram of pedagogical paths



- To moderate, guide, direct and support the learning process of the students.
- To support the development of cooperation.
- To help the students overcome difficulties relating to the school tasks.
- To help the students build a repertory of cognitive and metacognitive strategies necessary for the execution of tasks.
- To teach students to transfer acquired knowledge.
- To implement interactive formative evaluation practices.
- To teach students how to develop their capacity for metacognition
- To help students construct a positive concept of their learning capacity.

c) Pedagogical paths

Moderate, guide, direct and support the students' learning process

- To actualize the conditions and the activities so students can overcome obstacles and build their knowledge of the learning task.
- To differentiate and vary the presentation of information, the ways of processing data as well as the didactic means so as to take into account the various cognitive styles and abilities of the students.
- To implement learning situations which make it possible for the students to identify the attributes of the concepts based on the confrontation of examples and counter-examples, so as to build meaning.
- To help the students progressively organize and reorganize acquired knowledge in their memory based on their organizational structures.

Support the development of cooperative learning

- To implement cooperative learning situations that allow students to discuss their knowledge and know-how, validate, compare, confront, exemplify, reformulate, perceive the same reality under different angles, change perspectives, modify and correct their concepts.

- To help the students acquire the personal and social skills necessary in cooperative work, such as the feeling of belonging, sharing, the pooling of efforts, self-confidence and trust in others, mutual assistance, the respect of others and acknowledgement of their differences, the ability to listen and the coherent and respectful expression of one's ideas and the ability to solve conflicts.

Help the students overcome difficulties relative to tasks

- To explain the usefulness of the tasks and establish links to established goals.

- To teach the students to plan, supervise and correct the execution of their learning tasks.

- To support the student throughout the learning situation based on the value, requirements and mastery of the task at hand.

- To be attentive to negative attitudes, discouragement and unexpressed needs for assistance; to intervene when necessary.

- To teach the students how to overcome stress and anxiety when faced with difficulties.

- To teach the students to use their prior knowledge and personal resources to overcome a difficulty.

- To teach the students to become aware of the loss of meaning, of doubts and feelings of helplessness, to verbalize them and ask for assistance.

Help the students build a repertory of cognitive and metacognitive strategies necessary for the execution of tasks

• To teach explicitly through:

- modeling,
- guided practice,
- cooperative practice,
- independent practice, the "what", "why", "how" and "when" of cognitive and metacognitive strategies: for the construction of procedural and conditional know-how:
    - ° reading strategies,
    - ° writing strategies,
    - ° problem solving strategies in all disciplines,
    - ° research, collection and data processing strategies,
    - ° study strategies,
    - ° strategies to pass their examinations,

- the execution of tasks:
    - ° how to plan, supervise and correct the execution of a task.

- the application of work methods and techniques:

° how to use an agenda and manage one's time,
° how to organize one's work and leisure time more effectively,
° how to take notes and organize them,
° how to organize one's study places and study time,
° how to plan for the study of the various subject matters,
° how to carry out a review and prepare for an examination,
° how to do an examination and overcome stress.

Teach students how to transfer acquired knowledge

- To guide and support students in the execution of complete and complex tasks or the resolution of problem cases which support the conscious transfer of acquired knowledge.

- To assist students in the recognition and verbalization of the knowledge and the competencies they transfer before, during and after the learning.

- To teach students explicitly how to transfer knowledge, through modeling, guided practice, cooperative practice and independent practice.

- To clarify for students the situations of contextualization, de-contextualization and re-contextualization of knowledge so that they can consciously build their ability to transfer knowledge.

- To help the students become aware of the situations and contexts in which they transfer knowledge, and to plan for situations in which their knowledge can be transferred.

2.31 *Implement formative evaluation practices*

- To help the students understand the meaning and usefulness of formative evaluations, before, during and after learning.

- To explain to the students when, how and why they must take part in formative evaluation activities.

- To teach the students to adopt a positive attitude with regard to errors.

- To teach the students self-evaluation, co-evaluation and self-correction strategies.

Teach students how to develop their capacity for metacognition

- During the learning task, to frequently moderate their objectivation of the acquired knowledge and the processes which made it possible to construct knowledge and know-how, i.e. help the students become aware of the way in which:
  - they learn;
  - they carry out the tasks;
  - they overcome difficulties;
  - they implement a strategy;
  - they proceed to solve a problem;

  and to express it in their own words.

- To revisit prior knowledge during the learning process so students can correct and reorganize their knowledge as well as establish links between it and the new knowledge.

Guide the students in the construction of a positive concept of their ability to learn

- To help the students see how feedback and objectivation during the learning process, are favourable for the deepening of knowledge.
- To guide the students in the recognition and evaluation of their progress.
- To help the students attribute their successes and failures to strategies that may or may not be effective as well as to the effort invested in the process.
- During the learning process, to help the students become aware of their ability to learn and to express it in their own words.

2.2.3 The integration stage of the learning process

Where the student objectifies, at the end of the learning process, the acquired knowledge and the cognitive and metacognitive strategies used to evaluate, generalize and transfer the knowledge to other situations.

a) *Some theoretical elements*

The integration stage must offer the student the opportunity to actualize his ability to transfer knowledge and to cast a critical glance on the whole process, to take stock of his learning and to set new objectives.

Using synthesis, complete and complex tasks as well as problem solving, the student is taught to actualize and generalize his acquired knowledge to achieve greater mastery. The professor must help the student recognize the importance of this stage of learning, so he may consciously learn how to transfer his knowledge. During the integration stage, as in the realization stage of the learning process, the student must be put in situations where he can practice explicit transfers so he can acquire, objectify and evaluate his expertise in the field of study.

Frequently, this integration activity becomes the subject of the summative evaluation. Theory was introduced, practical exercises were done, and fragmented tasks were completed without requiring the student to carry out complete and complex tasks or syntheses that are necessary for formative evaluation feedback and regulation. Too often a summative evaluation is done on knowledge that is unfinished, not fully integrated and still in the construction stage. When this happens, results show students who cannot transfer knowledge. Many accept these results and move on.

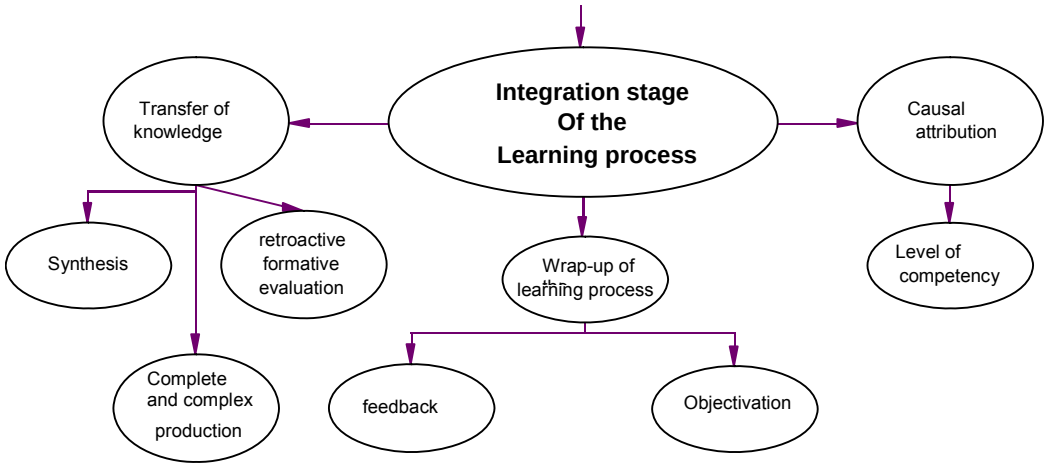
To take stock of the journey completed by the student constitutes the other side of the integration stage. The student must gauge the depth of his acquired knowledge relative to the knowledge required. He must become aware of the fact that his success or failure depends on the effort he puts forth; and, the implementation of effective or ineffective strategies. The professor's role is to help the student see the results of his efforts and strategies so that greater independence and accountability will ensue. By becoming aware, the student acquires a feeling of self-efficiency and security in relation to learning tasks and builds a positive self-image of himself as a learner.

b) *Organizational diagram of pedagogical leads*

Where the student objectifies, at the end of the learning process, the acquired knowledge and the cognitive and metacognitive strategies used to evaluate, generalize and transfer the knowledge to other situations.

.

Organizational diagram of pedagogical paths



- To support the transfer of knowledge.
- To moderate the feedback and the objectivation of acquisitions in the learning process.
- To review causal attributions relative to the student's capacity for learning.

c) Pedagogical paths

Support the transfer of knowledge

- To introduce new situations and contexts so the students may recognize the conditions of use for the knowledge and know-how they have processed:

  - synthesis:
    - complete and complex tasks;
    - problem solving.

- To help the students generalize the rules, principles, concepts and skills.

- To help the students plan for potential transfers of the learning they have mastered.

Moderate the feedback sessions on the student's learning process.

- To help the students become aware of the progress they have made and to verbalize it.

  - what they learned relative to what they knew at the starting point;
  - how they learned;
  - the difficulties and methods they used to overcome them.

- To discuss with students the relevance and effectiveness of the cognitive and metacognitive strategies implemented.

Review causal attributions relative to the student's capacity for learning

- To be attentive to the degree of satisfaction of students concerning their success and progress.
- To assist students in a conscious and personal attribution of the results relative to their efforts.
- To help students construct or re-build their faith in their ability to learn through the implementation of effective strategies and strong efforts.

We have just concretely described the foundations, principles and teaching measures that help students "learn how to learn". To be focused on what goes on in the thoughts of the learner, to listen to the learner express his difficulties, to see what he does or does not understand, to implement all that it is necessary for him to overcome these difficulties, to guide him and support him in the progressive construction of his knowledge, to make him conscious of his way of learning, to help him interiorize the results of his commitment, to assist him in the construction of a positive self-image of himself as a learner; all of this is part of the message we want to convey here.

Bibliography

AMES, R., et C. AMES. «Motivation and Effective Teaching», in JONES et IDOL, *Educational Values and Cognitive Instruction: Implications for Reform,* Hillsdale, NJ, Lawrence Erlbaum Associates, 1991, p. 247-271.

ASTOLFI, Jean-Pierre. *L'école pour apprendre*, Paris, Éditions E.S.F. 1992.

BARTH, Britt-Mari. *Le savoir en construction*, Paris, Édition Retz, 1994.

BORKOWSKI, GARR, PRESSLEY, RELLINGER, «Self-Regulated Cognition : Interdependence of Metacognition, Attribution and Self-Esteem», in JONES and IDOL, *Dimensions of Thinking and Cognitive Instruction,* Hillsdale, NJ, Lawrence Erlbaum Associates, 1991, p. 53-91.

BOUFFARD-BOUCHARD, Thérèse. *Influence de l'affectivité et de la motivation dans l'autorégulation par l'élève de ses activités cognitives et métacognitives,* Conférence, 1991.

DWECK, C. «Motivation», in LESGOLD, A., et R. GLASSER, *Foundation for Psychology of Education,* Hillsdale, NJ, Lawrence Erlbaum Associates, 1989, p. 87-136.

DELANNOY, Cécile. *Une mémoire pour apprendre,* Paris, Éditions Hachette, 1994.

GIASSON, Jocelyne. *La compréhension en lecture*, Boucherville, Éditions Gaétan Morin, 1990.

GIASSON, Jocelyne. *La lecture, de la théorie à la pratique,* Boucherville, Éditions Gaétan Morin, 1995.

MARTIN, Lyne. *La motivation à apprendre : plus qu'une simple question d'intérêt,* Montréal, CECM, Service de la formation générale, 1994.

MEIRIEU, Philippe. *Apprendre... oui, mais comment?* Paris, Éditions E.S.F. 1990.

Vie pédagogique, dossier : «Apprendre pour penser, penser pour apprendre» Québec, n^{o} 77, mars 1992, p. 15-43.

TARDIF, Jacques. *Pour un enseignement stratégique. L'apport de la psychologie cognitive,* Montréal, Éditions logiques, 1992.

TARDIF, Jacques, et Yolande OUELLET. «Vers un plus haut degré de professionnalisation : un scénario d'interventions avec des enseignants du primaire et du secondaire», *Cahier de la recherche en éducation, Thématique, La pratique, source de recherche et de formation*, Université de Sherbrooke, Faculté de l'éducation, Éditions de CRP, 1995, p. 57-88.

VIAU, Roland. *La motivation en contexte scolaire,* Montréal, ERPI, 1994.

Document 18

Ten fields of competency recognized as a priority in the continuing education of professors

By Philippe Perrenoud[57]

The ten competency fields of listed below do not claim to cover the entire teaching profession. Without being exhaustive, the table below highlights the fields that figured prominently in the list of requirements for professors, changes to primary schools and new training. Courses and seminars are offered to assist in identifying the disciplinarian and transversal contents of the fields.

Reference competency	**Specific competencies implicated in continuing education (examples)**
1. To organize and facilitate learning situations	• To know the disciplinarian contents to be taught and how they translate into learning objectives • To organize work based on the students' conceptual models • To work from errors and obstacles to learning • To build and plan didactic devices and sequences • To engage the students in research activities, in knowledge projects.
2. To manage the progression of learning	• To create and manage problem cases adjusted to the level and potential of the students • To acquire longitudinal vision of objectives in primary teaching • To identify links to the theory behind the learning activities • To observe and evaluate the students in learning situations, based on a formative approach • To establish periodic assessments of competencies and to make decisions relative to progress.
3. To create and fine-tune differentiation systems	• To manage heterogeneity within a classroom group • To de-compartmentalize, broaden classroom management to a larger group • To practice integrated support, to work with students in difficulty • To develop cooperation between students and inter-teaching.
4. To involve students in their learning and their work	• To stimulate the desire to learn, clarify the relationship to knowledge, the meaning of school

[57] Excerpt from: http://www.offratel.nc/magui/ORGANSR.htm

	work and the child's capacity for self-evaluation • To create an active student council (classroom or school council) to negotiate with students on rules and agreements • To support the defining of a personal project by the student.
5. To work in a team	• To elaborate a team project, common conceptual models • To moderate a work group, to lead meetings • To train and revitalize a pedagogical team • To confront and analyze complex cases, professional practices and problems as a team • To manage crises and conflicts between people.
6. To take part in school management	• To elaborate, negotiate a management project • To manage the resources of the school • To coordinate and moderate a school with all its partners (extra-curricular, district, parent associations, language professors) • To organize and grow student participation within the school.
7. To inform and involve parents	• To moderate information meetings and debates • To lead talks • To involve parents in coaching activities that validate the construction of knowledge.
8. To use new technologies	• To use publishing software • To exploit the didactic potential of software in relation to the objectives of the teaching field. • To make remote learning available through telematics • To use multimedia tools in teaching.
9. To face the ethical duties and dilemmas of the profession	• To prevent violence in and outside the school • To fight against prejudice and sexual, ethnic or social discrimination • To take part in the establishment of general rules relative to discipline at school, sanctions, behaviour. • To analyze the pedagogical relationship, authority and communication in the classroom. • To develop a sense of responsibility, solidarity, a feeling of fair play.
10. To manage one's own ongoing learning	• To be able to explain one's practices • To establish one's personal assessment of competencies and personal program of continued

education

- To negotiate a general education project with colleagues (team, school, network)
- To involve oneself in tasks at the professional level, teaching level, etc.
- To welcome and take part in the education of colleagues.

Document 19
Methodological guide for elaborating a problem situation

By Philippe Meirieu; *Apprendre ...oui, mais comment?* (ESF éditeur) [58]

The validity of a pedagogical model is based on 3 essential elements:

- The quality of the ethical project which inspires it (what we would like the learning to be)
- Its conformity or at least non-contradiction with the contributions of humanities (what we know about the subject)
- The fruitfulness of the approach (what we can do with it so that it becomes what we want it to be).

Based on these essential premises, a recommendation as to the model of pedagogical organization can be made in accordance with the problem situation.

1. **The principle: "every lesson must answer a question" (J. Dewey)**
   The pedagogical situation must provide answers to questions and problems that the learners are asking themselves; it presupposes a pedagogical device where problems and answers are articulated explicitly, where answers can be constructed by the learner and integrated into the dynamics of final learning.
   "An explanation is useless without the question that prompts it and which gives it meaning (…).A true pedagogy is not the teaching of explanations but of culture, that is the cult of explanations." (L.Legrand)

2. **Two symmetrical obstacles: “answer pedagogy” and “problem pedagogy"**
   “Answer” pedagogy consists of explanations which we presume, provide solutions to problems. Faced with the heterogeneity of learners, this professorial pedagogy is one of randomness: it effectively serves as a selective function. “Problem” pedagogy (active methods, concrete situations, etc.) place the learner in front of a task that enables him to learn. This approach which can seem quite satisfactory comes up against two important obstacles.

   2.1 In the development of a project, there are no guarantees on the progression of difficulties, and nothing guarantees that "good questions" will come at the right time.
   2.2 “Problem” pedagogy tends to ignore the fact that when faced with a difficulty, learning is almost always the costliest solution. It is so much easier not to learn, to call on someone else who will solve the problem for us, to seek a ready made solution. The risk is taking a project to fruition without learning taking place.

   The pedagogy of problem situations must avoid these obstacles. It is necessary to introduce a problem to be resolved, and recognize that there can be no solution to the problem without learning.

[58] Translated from: http://perso.wanadoo.fr/philippe.martin/MERIEU.htm

3. **The problem situation: a subject, carrying out a task, confronts an obstacle**
   The pedagogical mechanism is designed to introduce a situation that has certain logic:
   - A task is proposed to the learner.
   - This task can only be successful if an obstacle is overcome (the acquisition sought by the instructor)
   - Due to a system of constraints, the subject cannot complete the project without confronting the obstacle
   - Thanks to a system of resources, the subject can overcome the obstacle.

4. **The subject is oriented by the task, the instructor by the obstacle**
   In a problem case, the main educational objective is in the obstacle to surmount and not in the task to carry out (even if it is the criterion used for the success of the project).
   Even though it is always presented to the subject as a task to be carried out, a problem case must nevertheless be designed by the instructor based on the targeted acquisition.

5. **Surmounting the obstacle must be a stage in the cognitive development of the subject**
   The instructor must determine his pedagogical objectives according to what will constitute an obstacle to be surmounted and that will represent a decisive stage in the cognitive development of the subject.
   The objective should always be articulated in relation to what represents a cognitive obstacle for the subjects. It is necessary to place this obstacle precisely at the heart of the problem case so it may be overcome.

6. **The obstacle is overcome if the materials and the instructions provided bring about the targeted mental operations**
   All learners do not have same academic or cultural prerequisites. It is therefore appropriate that the mechanics of the problem case be constructed in such a way that it embodies the necessary mental operations yet allows those who have not yet mastered them to carry out the task nevertheless.
   As concerns the obstacle encountered, specific educational mechanisms (confrontation groups, inductive regrouping, etc.) are put into place to overcome the cognitive obstacle.

7. **To carry out the same mental operation, each individual must be able to use a different strategy**
   What is interesting about the problem case is that it combines great structural directivity and flexibility in its individual treatment. Each learner implements his own personal learning strategy.

8. **The creation and implementation of a problem case must be regulated by a set of evaluation mechanisms**
   The relevance of a problem case is subordinated to the quality of **the diagnostic evaluation** to determine the competencies and ability of the subject, and the nature of the learning.
   Evaluation during the learning situation is **formative** if it contributes to identifying effective work procedures and a sufficient formalization of these to facilitate their realization.
   The evaluation of the acquisition itself and its true appropriation require a "de-

contextualization" using different exercises and is more the subject of **a summative evaluation**.

In conclusion and to summarize the above, Meirieu proposes four important questions to be asked for the construction of problem situations:

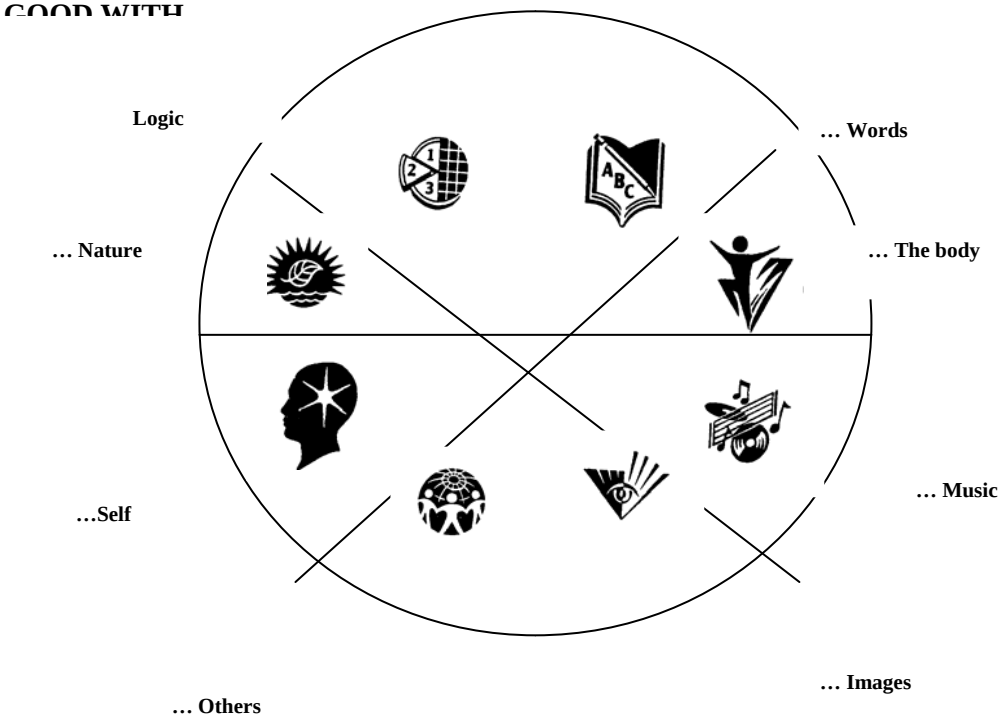
- What is my objective? What do I want to have the learner acquire that represents for him an important stage of progression?

- What task can I propose that requires access to this objective in order to be successfully completed (communication, reconstitution, enigma, repair, resolution, etc…)?

- What mechanism should I put in place to ensure that the mental activity called on to carry out the task meets the objectives?
  What materials, documents, and tools should I have*?*
  What instructions-goal should I provide so that the learners use the materials to achieve the task?
  What constraints are necessary to prevent the subjects from circumventing the learning?

- What activities can I introduce that will enable the use of various strategies? How to vary the tools, processes, degrees of guidance, and methods of regrouping?

Document 20
Multiple intelligences[59]



The concept of the multiple intelligences is compatible with research on the uniqueness, enrichment and modular operation of the brain. As is the case for other concepts that are allegedly based on the functioning of the brain, this concept can be misused. It is a useful model, not an "absolute truth".

Logical-mathematical intelligence

It is characterized by: Strength in problem solving and in mathematics. Asks questions such as "why" and "how", wants to reason things out, wants to know "what will happen next" and thinks "sequential". **Paths that support its expression:** To work with a computer, to write applications, program, separate objects, classify, read, discuss, explore, solve mysteries, play with words, to decipher codes, visit museums, solve enigmas, outline, group, propose problems requiring thinking and calculation activities.

Visual-spatial intelligence

It is characterized by: A powerful imagination. Likes to: design, draw, read graphs, posters, puzzles displaying images, mazes, organize space, objects and surfaces. Needs images to understand. **Paths that support its expression:** art, the practice of sports, the creation of maps, the organization of ideas, the assembly of videos and films, the construction of maps and charts,

[59] SIROIS, Gervais, Centre d'étude et de développement pédagogique inc. cf p.222

theatre, windsurfing, sculpture, in-line skating, movement in the dark, dance, bicycle, driving and painting.

Interpersonal intelligence
It is characterized by: Great people skills. Likes to speak and influence, usually leader in a group, an organizer, communicates well, skilful in conflict resolution, is a good listener, skilful at negotiating and is persuasive. **Paths that support its expression:** To make friends easily, prefer win/win situations, lead discussions, practice teaching by peers and collaboration, direct projects, give advice to friends, understand the concerns of others, and express empathy.

Body-bodily-kinaesthetic intelligence
It is characterized by: The desire to move! Needs to be in constant movement or actively involved in order to be well. A need to get up, move, touch, handle and play with things. **Paths that support its expression:** To stretch, role play, to create dramatic scenarios, do exercise, theatre, practice hobbies and arts & crafts, play, plan outdoor events, dance, play and engage in sports.

Verbo-verbal-linguistic intelligence
It is characterized by: Love of language and words. Talks constantly, has a good memory for dates and names, likes to tell stories, likes to listen to stories, likes the diversity of voices and remembers funny stories. **Paths that support its expression:** To make presentations, like to argue, persuade, and make speeches, play different roles, dialogue, write, make reports, initiate conversation, listen to recordings, and read: particularly books containing dialogues.

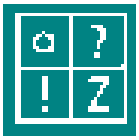
Intrapersonal intelligence
It is characterized by: Love of solitude. Likes to reflect, has a good understanding of strengths and weaknesses, is skilful in defining objectives and feels good when he is alone. **Paths that support its expression:** To think up strategies, imagine, write a journal, relax, learn about oneself, practice concentration exercises, reflect, contemplate, and reserve times alone to reflect.

Musical-rhythmic intelligence
It is characterized by: The pleasure of making music, sounds or rhythms. Likes to hum, keep the beat and sometimes sing. **Paths that support its expression:** To keep the beat, attend concerts, use background music, sing, make music, write songs, create team slogans, use and play musical instruments.

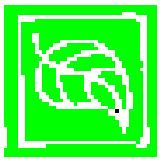
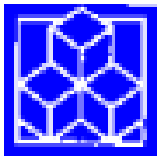
Naturalist intelligence
It is characterized by: Skill to organize, select, gather, list. **Paths that support its expression:** To design systems, structure ideas, ask questions, put things in order, gather people (according to the learning styles, multiple intelligences), garden, create interior designs, conduct scientific research, teach, administer, inquire, involve, do police work, explore, do brainstorming and to group together.

Table of multiple intelligences

Intelligence	What it is...	This student likes...	The professor can
2.32 **Interpersonal** 	• Sensitive to the feelings and moods of others • Understands and interacts effectively with others	• To have many friends • To be the leader, share, be the mediator • To build consensus and to empathize with others • To work efficiently in a team	• Use cooperative learning • Plan group projects • Give the students opportunities to teach their peers • Do brainstorming on possible solutions to a problem • Create situations in which students give each other mutual feedback.
2.33 **Intrapersonal** 	• Sensitive to his own feelings and moods • Knows his own strengths and weaknesses • Uses self-knowledge to guide himself in his decision-making and his definition of objectives	• To control his own feelings and moods • To pursue personal interests and keep a personal journal • To learn while observing and while listening • To use his metacognitive skills	• Allow the students to work at their own speed • Plan individual self-directed projects • Provide the students with opportunities to give mutual feedback • Lead the students to write a logbook and/or use other means of reflection

Intelligence	What it is...	This student likes...	The professor can
Body-bodily-kinaesthetic 	• Uses his own body to communicate and solve problems • Works with objects and activities involving fine and global motor skills	• To practice sports and to be active physically • To use body language • To do arts & crafts and mechanical projects • To dance, act in theatre and mimic	• Propose tactile activities or activities involving movement • Occasionally do role play and theatre • Involve the students in physical activities • Allow the students to move around during class • Propose sewing activities, manufacturing models or other activities requiring fine motor skills
2.34 **Verbal-linguistic** 	• Thinks in words • Uses language and words in many different ways to express complex thinking	• To tell jokes, enigmas and puns • To see, write and tell stories • To use a rich vocabulary • To play games using words • To create poems and stories using the sounds and imagery of words	• Create reading and writing projects • Help students to prepare speeches • Involve the students in debates • Make games with cross words, crossword puzzles and the search for words • Encourage the use of puns, palindromes and plays on words

Intelligence	What it is...	This student likes...	The professor can
Logical-mathematical 	• Approaches problems logically • Understands abstract numbers and patterns • Recognizes and solves problems of reasoning	• To work with numbers, understand things and analyze situations • To know how things work • To ask questions • To show precision in problem solving • To work in cases where it is clear that the solutions are black or white	• Have students construct Venn Diagrams • Use strategy games • Bring students to show their comprehension by using concrete objects • Represent information on graphs • Build a timeline and draw maps
Musical-rhythmic 	• Sensitive to the non-verbal sounds of the environment, including melody and tone • Conscious of the patterns of rhythm, intonation and tone	• To listen to and play music • To synchronize his feelings according to the music and the rhythms • To sing, hum and move to music • To remember and work with various musical forms • To create and recreate melodies	• Rewrite the words of a song to teach a concept • Encourage the students to add music to their games • Create musical mnemotechnic tools • Teach history via musical periods • Encourage students to learn music and folk dance from other countries

Intelligence	What it is...	This student likes...	The professor can
Naturalist 	• Is sensitive to the natural words • Sees links and patterns in the field of plants and animals	• To spend time outside • To observe plants, collect rocks and try to catch animals • To be attentive to the sounds of nature • To observe the relations in nature • To categorize and classify the flora and fauna	• Use the outdoors as the classroom • Bring plants and animals for which the students will be responsible in the classroom • Organize hands-on experiences in sciences • Create a nature zone in the recreation yard
Visual-spatial 	• Perceives the visual world with precision • Creates mental images for itself • Thinks in three dimensions • Is conscious of the relations between objects in space	• To doodle, paint, draw or create 3-dimensional models • To look at charts • To complete puzzles and mazes • To dismantle objects and reassemble them	• Draw charts and mazes • Have students do visualization activities • Provide opportunities to show comprehension by drawings and paintings • Bring students to draw clothing, buildings, playgrounds and stage decorations

Document 21
Problem-based learning

Active pedagogical formulas[60]

Within the scope of a series of four articles devoted to the presentation of active pedagogical formulas, *Le Trait d'union* introduces the case study, problem-based learning and project based learning. The formulas described in this series of articles have a common goal: to support quality in-depth learning. There exists multiple ways of putting these pedagogical formulas into practice, and it would be limiting to present a uniform image of them (Frenay, 1996). However by calling on prior experiments, we can identify a general outline for each formula. Here is the second article in the series.

Problem-based learning

The pedagogical formula known as problem-based learning (PBL) targets the acquisition of knowledge, the development of higher-order skills and the transfer of knowledge. Based on complex and meaningful problem cases, a learner constructs a conceptual model of problems and makes assumptions that will be confirmed or invalidated by documentary research.

In the PBL formula, the accent is placed on the active character of learning. Analysis of the problem case, during the discussion, places the student in a position to use all his knowledge on the subject, thus supporting the creation of links between the new knowledge and those already in memory.

The problem cases originating in professional practices are complex and meaningful. According to Barrows (1986) they contribute to support the motivation of students through the control the PBL process has over the task. The task is perceived by the students as being legitimate and useful.

In addition to having an impact on the quality of the acquired knowledge, PBL contributes to the development of higher-order skills. The implementation of such a formula supports the development of skills such as the ability to evaluate the relevance of available resources, self-learning, and the ability to effectively use one's knowledge, the ability to continuously update and shore up one's knowledge (continuing education, improvement). All these skills form the base of expert reasoning in a given field.

PBL at Université de Sherbrooke

[60] Translated from http://www.usherb.ca/sse/tu/decembre/app.htm

This pedagogical formula was quite revolutionary 14 years ago, when under the direction Jacques E. Des Marchais, now professor emeritus, the Faculty of Medicine decided to establish PBL in its training program for doctors (MD).

The pedagogical formula is now running smoothly and the Faculty has acquired an international notoriety in medical pedagogy, in particular from the perspective of using problem-based learning. The Faculty of Education was to some extent a partner in this teaching development via the contribution of René Hivon and Jacques Tardif, professors at the Faculty of Education, for the putting in place and experimentation of the formula. PBL is used elsewhere at the University, though on a more limited scale than that of an entire program, in particular in nursing sciences and education.

The tool

The problem cases are used as **pretexts** that cause the emergence of the students' prior knowledge and orient the new knowledge needed for **the comprehension** of the problem. It is the instructor or professor who chooses the topics and writes up the problems. A problem is about one page in length. It relates to a topic which will activate the knowledge to be acquired. Barrows (1985) lists four categories of themes that orient the drafting of the problems:

- **Impossible to circumvent:** Problems most frequently encountered in professional practice.
- **Serious cases:** Problems which, although they are not very frequent, involve serious consequences if they are not identified or are not solved correctly. (i.e. in medicine, the diagnosis of meningitis, or for a psychologist, suicidal symptoms in teenagers)
- **High stakes:** Problems whose social or economic impacts are very important. (i.e. in medicine, knowledge related to AIDS or toxic shock syndrome)
- **Pools of knowledge:** Problems which make it possible to introduce the students to a vast extent of basic knowledge related to the field of study.

The method

The method is prescriptive; it is the instructor who controls the whole process. The heart of the PBL process is the problem case that the students must understand in a group, then formulate **explanatory assumptions** of the problem and learning objectives. These hypotheses and learning objectives will serve to guide individual study. The goal of the study is to fill the gap between what the student knows about the problem and what the theory reveals about this problem.

The PBL process can be summarized in four stages:

- Stage 1**:** Discussion around the problem case in small groups of 5 to 7 people to facilitate exchanges.
- Stage 2**:** Individual study to search for information.
- Stage 3**:** Review in small group with new information resulting from the individual study. Students present information which they collected during stage 2. The professor then validates the information.

- Stage 4**:** Individual self-evaluation and drafting of an assessment of acquired knowledge by the students.

The tutorial
(Stages of PBL)

Stage 1 (in small group)

1. Read the problem
2. Define the problem
3. Analyze the problem
4. Organize the explanatory assumptions
5. Formulate learning objectives

Stage 2 (individually)

6. Individual study: bibliography, library, experts, others

Stage 3 (in small group)

7. To synthesize and check information collected
8. To evaluate the tutorial and the work

Stage 4 (individually)

9. Self-evaluation of the stages of PBL
10. Assessment of acquired knowledge

Adaptation of Denis Bédard's *L'apprentissage par problèmes*, a paper presented in October 2000 within the framework of the pedagogical capsules of the Service de soutien à l'enseignement of l'Université de Sherbrooke.

Roles and tasks of the learner

The students play various roles during the discussions. They will be moderators, secretaries and scribes (the scribe is the one who notes and schematizes the table) in order to ensure the correct functioning of the discussion. The success of the discussion and the learning targeted by the professor depends on the active participation of all the students.

- **In stage 1,** the role of the student consists in taking part in the discussions of his sub-group so as to properly understand the problem. The student is also responsible to set the learning objectives that will guide his learning.
- **In stage 2,** the students proceed to a period of individual study of the concepts associated with the problem.
- **In stage 3,** they return in sub-groups to validate and discuss the result of their individual study as well as to confirm or void the explanatory hypotheses.
- **In stage 4,** the student is responsible for a self-evaluation and to carry out an assessment of his knowledge.

Roles and tasks of the professor

In a general way, the professor's role is well defined by the method. The professor acts as a tutor. He is responsible for facilitating and guiding the learning via the use of various strategies (Bédard, 2000):

- **Modeling:** To model the process of resolution, to formulate explicitly the cognitive and metacognitive strategies used to resolve the case.
- **Scaffolding:** To provide the appropriate support according to the skill level of the learners so that they can solve the problem.
- **Coaching:** To assist the students in the acquisition of knowledge and strategies. To observe the learners as they solve the problem and to offer instructions, give feedback, help recall information, direct the attention, etc.
- **Elimination:** To decrease the support as the students acquire independence.

The professor must help the students in their acquisition of the PBL process; he is therefore d**irectional as to the procedure** and the process to be followed, while avoiding as much as possible to provide theoretical information to the participants. His degree of intervention will vary according to the students' level of ability: his interventions are constant at the start, then fade with the practice and the growing ease of the participants.

When planning the activity

The professor:

- Identifies important elements of professional practice;
- Sets the learning objectives. He defines what the students are to learn **(what)** and how they will learn it **(how)**;
- Devises the problem cases;
- Plans for the analysis and resolution of the problem;
- Prepares the validation and testing of the problems;
- Prepares the references (bibliography, photocopies, collection of texts…);
- Prepares the evaluation tools.

During the intervention

In his role of tutor, the professor supports the acquisition of the PBL process and facilitates the operation of discussion groups. To do this, he:

- Anticipates the difficulties in the analysis or resolution of the problem;
- Manages uncertainty and complexity;
- Supports the articulation of the knowledge;
- Validates acquired knowledge;
- Supports reflection;
- Supports the exploration of the problem case;
- Synthesizes the information;
- Establishes a climate favourable to discussion;

- Stimulates motivation;
- Supports and ensures the participation of all the students in the discussion;
- Is available to answer individual questions during individual study periods (stage 2);
- Supports independence and action.

During the evaluation

The sub-group, at stage 4 of the process, carries out a review on the study questions and validates the assumptions and the knowledge. In this context, the tutor:

- Carries out the formative evaluation for the tutorial and the teamwork;
- Supports the articulation of the knowledge, reflection and exploration of the problem case;
- Models the use of cognitive and metacognitive strategies;
- Encourages the students to evaluate their approach and to criticize their own reasoning, encourages and guides the development of metacognitive skills;
- Stimulates motivation.

Evaluation of the learning

A formal evaluation is conducted periodically. It is normally associated with the analysis of a problem similar to those presented in the discussion groups. The students are thus required to follow the same process (analyze the problem, make explanatory assumptions, etc). Reasoning abilities, the ability to recover knowledge in memory, the ability to use one's knowledge and self-learning skills are all an integral part of the evaluation process.

What is the ideal formula?

According to Lebrun (1999), pedagogical formulas put the accent on one facet or another of the learning mechanism or on one facet or another of the role of professor. In spite of the qualities of the formulas presented, they all suffer from those facets that are less exploited. The ideal abstract formula does not exist!

It is up to the professor to pin on each one of these suggested methods, the ingredients that interest him so that he can build his own method. This choice will be determined by the objectives of the activity, the nature of the subject covered, the composition of the classroom group, the resources and the tools available, and finally the personal affinities of the professor.

References

1. BARROWS, H.S. (1985). *How to Design has Problem-based Curriculum for the Preclinical Year*, Springer Publishing Company.
2. BARROWS, H.S. (1986). "A Taxonomy of Problem-based Learning Methods", *Medical Education*, 20, p. 481-486.
3. BÉDARD, D. (Oct. 2000). *L'apprentissage par problèmes*, paper presented within the framework of the pedagogical capsules of the Service de soutien à l'enseignement of l'Université de Sherbrooke, .
4. BÉDARD, D. (2001). Free presentation given on February 8, 2001.
5. FRENAY, Mr. (1996). "Favoriser un apprentissage de qualité", *Enseigner à l'Université: un métier qui s'apprend?* , Brussels, Université De Boeck, Jean Donnay and Marc Romainville Publisher.
6. LEBRUN, Mr. (1999). *Des technologies pour enseigner, Brussels*, Université De Boeck.

Document 22
From theory to practice

Bank of methodological tools[61]
The problem situation

Presentation

Objective: to make each student aware of a problem, to put forth hypotheses, to build and practice a research approach so as to construct meaningful knowledge.

Field of application: themes (enigmas) that give rise to assumptions and allow for research or experimentation.

Transversal competencies:

The professor who decides to use this approach must determine beforehand the competency (ies) he is listing as principal objective and must adapt the activities and the timeframes accordingly.

Here are a few examples.

Relational competencies: ***Master one's emotional reactions with regard to others***

The periods for group work and the confrontation of ideas are the opportunity to establish rules of behaviour and to develop attitudes of listening and mutual respect.

Mental approaches: ***To use one's divergent thinking***

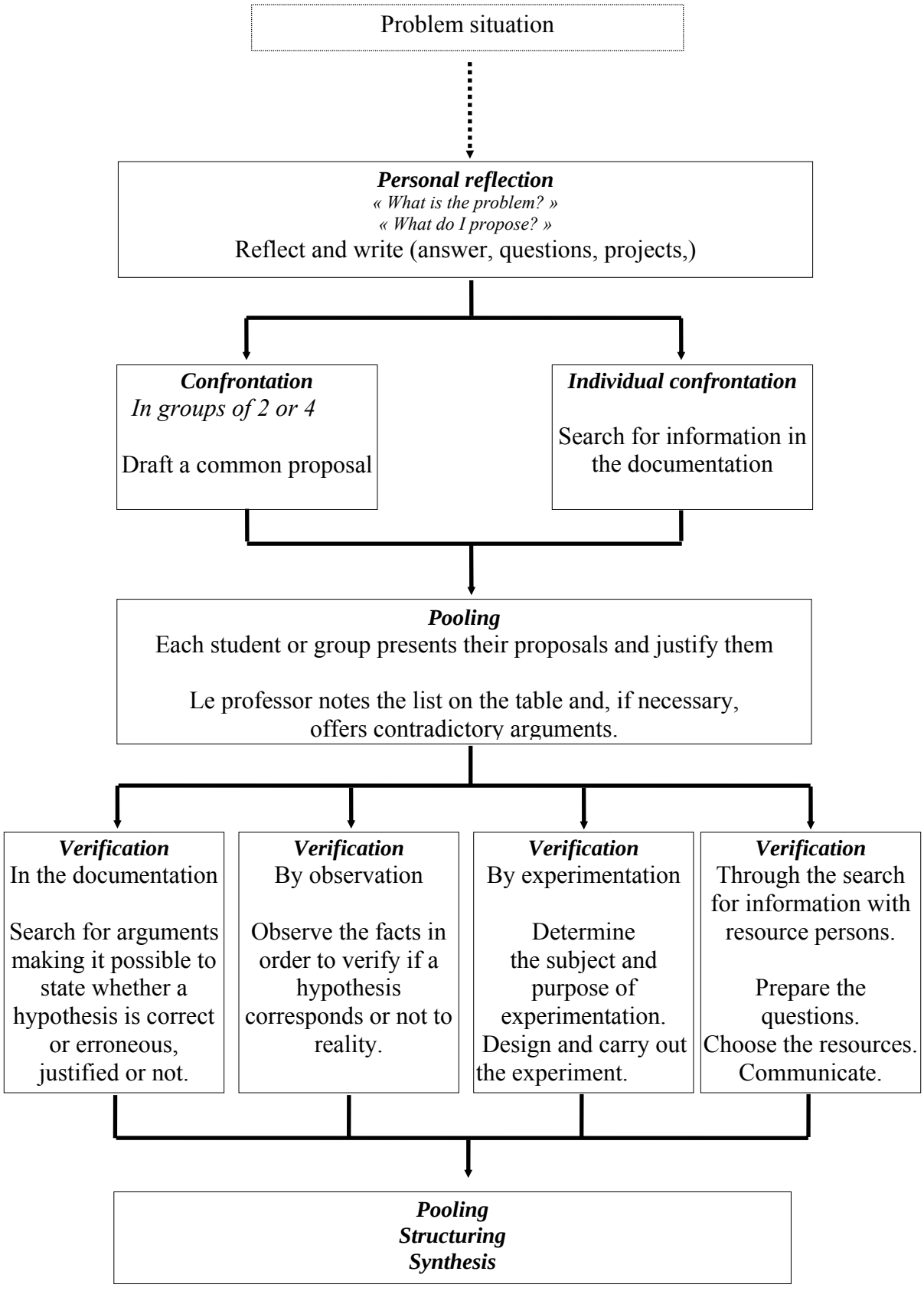
The problem exists precisely because the student has neither the answer, nor probably the procedure to solve it. We can choose to practice or observe this competency through a problem case that offers a broad field of investigation.

Methodological competencies: ***To communicate effectively***

The periods of confrontation, of pooling, make it possible to practice oral communication. The obligation to put the information to be communicated in writing makes it possible to refine the message. When pooling the information, the group makes an immediate evaluation "in the field".

[61] Translated from: By Jean DELIRE, mission leader, March 1995
http://www.agers.cfwb.be/pedag/ressources/fcc/doc011/Situprob.doc

Plan of sequence **Professor's record**



Comments

In real life, the situations we encounter do not come with questions but they must be faced and we do so by drawing conclusions from the data furnished.

1. To outline the problem case

An interesting problem is not one that comes from the professor's book, with a question requiring the student to answer in standard fashion. An interesting problem (pedagogically) is **the enigma** that appears in front of the student within his own field of experience. This situation will generally be arranged by the professor, within the framework of the objectives and respecting the following principles:

1. The principal objective of the learning situation is the obstacle to surmount and not the task to be realized.

2. If possible, the question (the enigma) should come from the student (or the classroom). The student will only commit himself to work when it helps him answer his questions.

3. The "answer" should not be obvious, but the student must "feel" that he is able to discover it. If the problem is too complex or too involved, the student will put the initiative on the shoulders of the professor. The problem must be positioned within the student's zone of proximal development. The targeted learning is not only the mobilization of acquired knowledge, but also the acquisition of new knowledge and the development of know-how.

2. To determine a work plan and direct the activities

This principle is designed **to make the students act** in a productive rather than a receptive manner. During independent work by the student, the professor finds time to intervene individually, more in the manner of a guide, moderator or advisor.

1. The student's work always starts with a stage of **personal reflection**. The purpose of this reflection is
   - the recognition of the case and the problem (*"What is happening, what do I see, what are we talking about? What is the problem?"*)
   - the production of personal elements (answer, suggestion, other questions, simple observation, project, etc.) with the obligation to write them down. The obligation to write down the result of the research forces the student to face the obstacle of verbalization and to concretize the fruit of its work.

2. The second stage must bring the student **to confront** his ideas versus those of others. Various situations allow for this: discussions in small groups, consulting documentation, seeking elements in his own experience or environment.

3. A **pooling** stage is generally indispensable. The professor asks each student or group to present their proposals and to justify them (briefly). The professor will avoid supplying answers or information. He will bring out contradictory elements so as to cause a re-examination by the student or the group. We are still at a stage of making hypotheses and not of structuring.

4. This is followed by a **verification** stage. Various routes are possible: search the documentation, experimentation, observation, and resource people. Each student or group can be asked to verify a hypothesis, either their own or another. We can differentiate the contents (different hypotheses) and the methods. Here too, the obligation remains to put down in writing, in one form or another, the research results.

. 5. The preceding stages bring the student to reactivate his knowledge, to bring out his conceptual models (concepts) and to confront them with other ideas and reality. This is to some extent, the "destabilization" that is essential to any learning situation. It is **imperative** that the professor "take them by the hand" so as to **restructure** all the ideas tossed around in these activities, to build **a synthesis** and to provide the necessary information. Let us not forget that all this work is intended ①to learn ②something!

Sequence of unfolding

1. **P** To present the topic

2. **E** Personal reflection: to ponder and put in writing in a few words, a drawing, a sentence…
   - To formulate the problem: what do I seek?
   - To propose elements of answers, or other questions, or verifications to be made
   - For the experimentation: distribute the student work record
3. **P** To set up groups of 4 students
4. **P** To distribute group instruction sheets.
   - To have the instructions read and their understanding verified.
5. **E** Work in groups
   - Each individual explains to the other three what he proposes
   - The group writes down common proposals
   - Indicate the names on the sheets
6. **P+E** Pooling
   - Each group presents its proposals
   - A list of them is put up on the board, if necessary
   - Comments of the professor
7. **P** Synthesis
   - To distribute the synthesis sheet
   - Reading and comments

Observations

1. Attitude of the students: very active, respect the instructions, share many ideas, ask a few questions only to the professor during the group work, but ask many within the group. It is important to advise students that it is okay to make mistakes at the outset. There will be neither sanctions nor loss of points, nor comments.

2. Many have the impression that students did not use the concepts seen in the previous courses. There is a clear distinction between "school" knowledge (that has been studied) and the knowledge resulting from personal experience. Practically all the elements the students bring to their work come from an "intuitive" knowledge of the subject. Also well documented is the lack of rigour in the use of the terminology, confusion between matter and state, temperature and heat. It seems that these words were received and stored, but were not integrated into "personal" knowledge. A discussion is very useful to establish all the links between this knowledge.

4. The number and the nature of the questions asked in the groups and during the discussion show the interest of the students for this type of activity. Information is provided by the professor only as answers to questions asked by the students.

5. It is important for the professor to review individual sheets so as to spot difficulties, questions, and erroneous conceptual models. It is not a matter of assigning a grade, but of collecting the elements to be dealt with in the following course.

Document 23

The schematization of concepts: a tool for developing conceptual skills at collegial level[62]

All professors know how hard it is to bring the student to connect his new knowledge to previously acquired knowledge, to develop good strategies for processing information and to reorganize his knowledge. This concern was recently the subject of a series of articles in *Pédagogie collégiale*..

This thinking is similar to that of American research carried out by Ausubel, Hanf, Jones, Heimlich, Novak… over the past fifteen years. These authors suggest the use of semantic networks for the development of learning (conceptual schemas, "flow charting", "semantic mapping"). The interesting aspect of these studies is the "mediation between student and knowledge[63]" as Saint-Onge puts it. This mediation passes through two compulsory stages: the learning strategy that is to be developed in the learner and the teaching strategy.
The pedagogical use of conceptual schemas reflects both preoccupations.

As a learning strategy, the production of schemas leads the student to organize by himself the structuring of his knowledge, to establish a hierarchy among concepts on which knowledge is based.

As a teaching strategy, the presentation of a conceptual model (in graphic form) serves the student as preliminary structuring agent from which he can organize the acquisition of new knowledge.
2.35

LEARNING

2.3 The work of a student in philosophy 401

The schema presented on the next page < not shown> illustrates the work of Myriam and is based on a text of about fifteen pages written by Micheline Carrier: "la pornographie, base idéologique de l'oppression des femmes[64]". Myriam devoted six hours of work here: four hours in the classroom and two at home.

At the end of her work, this student formulated the following reflections: "I did not have a choice. I had to understand it completely and it was only as the text progressed that I grasped its structure…" and "it was difficult, but worth the effort".
What happened, between the time Myriam received the text and the time she triumphantly gave in her schema for evaluation?

---

[62] Text translated from: BRETON, Jacques, ***La schématisation des conceptions : un instrument de développement des habiletés conceptionuelles au collégial***, Pédagogie collégiale, 4, no 3, Feb.1991, p. 18-23.
[63] Saint-onge, Michel, *Moi j'explique, mais eux, apprennent-ils ?*
[64] CARRIER, Micheline, "La porrnographie , base idéologique de l'oppression des femmes", in *Against violence*, 1981.

2.3 Preparation of the text under study

The text proposed to the students had been prepared for the purpose of facilitating its in-depth comprehension:

- a synopsis defining the scope and the stakes; this information was completed verbally in the classroom;
- a list of the principal conceptual elements in the text, often new for the students, was drawn up;
- the paragraphs of the text had been numbered from 1 to 64 to facilitate the location of the ideas and the 'coming and going' of attention during the execution of the task;
- a statement, inserted in relation to each of the various paragraphs, oriented the reading;
- the text was presented in a very aerated form, allowing the "operational start-up of thinking" by the use of a pencil, underlining, the inscription of benchmarks, the formulation of synthesis proposals, the clarification of links, the drafting of mini-schemas, etc.

2.3 Preparatory activities for the task of schematization

A series of four activities moderated by the professor gradually prepare the students for the upcoming task. The purpose it to have students schematize a text in its entirety so that the dominant idea of each paragraph is seen in the schema. The overall schema should reflect the global structure of the text.

1. The first activity examines the principal conceptual elements of the text starting from a list provided beforehand. An exchange moderated by the professor then takes place to allow each individual to validate his understanding of the concepts, to identify their key features and define them.
2. In a second stage, the students read the text to formulate hypotheses on its structure. This stage lasts approximately fifteen minutes. Just long enough to allow the identification of key points but not an in-depth reading.
3. Collective results are then summarized to characterize the macrostructure of the text and a discussion with the group helps to identify key elements at stake. At this stage, each student has assumptions on the text and on the way to resolve the problems.
4. Finally each work team could begin its analytical reading of the text and gradually build a schema.

2.3 Design of a conceptual schema

Jones[65] defines conceptual schemas (graphic representations) as "the visual representations of verbal statements". There are several types of schemas: comparative tables, family trees, stock exchange graphs found in newspapers, etc. These schemas have in common the fact that they illustrate a complex network of information at a glance. Contrary to a text, this form of

[65] JONES, Beau FLY, PIERCE, J and HUNTER, Barbara, "Enseigner aux étudiants à construire des représentations graphiques", in *Educational Leadership*, vol. 46, nº 4, 1989, p. 20-25.

representation allows for a nonlinear treatment of information. Each schema is adapted to the structure of the material which it contains.

The schema produced by Myriam on pornography adopts a free style, illustrating the information provided in the text but reorganized by the author, according to the limitations of her comprehension and creativity. In this schema, key conceptual elements are surrounded by a circle or a rectangle and constitute the basic "nodules". Each "nodule" contains a concept or words that form a semantic unit. The nodules are connected by lines or arrows which further emphasize their connection. When two "nodules" are joined by a line or arrow, they are considered a distinct proposition. The overall network illustrates the global structure of the subject under study.

To build a conceptual schema:

- We highlight key concepts in the text and major propositions;
- We draw up a list of all conceptual elements to include in the schema. We can write these elements down on small cardboards to facilitate their positioning during regroupings;
- We then position "nodules" on the paper with each nodule representing a key concepts (from top to bottom in order of priority);
- We carry out several regroupings until the schema has the desired form;
- We finish by specifying the nature of the connections which link the conceptual elements.

2.3 Thought processes involved in schematization

Hanf [66] recalls an expression by Hilda Taba: "to schematize is to think". He adds: "the reader must carry out the same type of organization and analysis of ideas that we attribute to higher thinking operations". The learner who schematizes a text or a process accomplishes the major operations of intelligent reading. He must distinguish the dominant ideas from the secondary ideas and connect the ideas among each other. He must "apprehend the concepts hidden behind the words [and] see the thought behind the structure of the sentence[67]". He sets in operation what Palkiewicz's[68] taxonomy defines as being conceptual thinking: to classify, prioritize, connect, interpret and transpose.

Schematization forces the mind to distinguish the contents from the functions (structures and relations) played by the various segments of the text. It obliges us to pay particular attention to the logical indicators of the semantic relations found in the text.
"The concepts derive their meaning from each other[69]. The various rearrangements involved in the creation of a schema cause the students to recognize the multiple links; and to exercise their capacity for grasping the nuances of conceptual thinking.

---

[66] HANF, Buckley Mr., "Mapping: A Technology for Translating Reading into Thinking ", in *Journal of Reading*, 1971, p. 225 and following. CLIBURN, Joseph W Jr," Conception Maps to Promote Meaningful Learning ", in *Journal of College Science Teaching*, 1990, p. 212-217

[67] AYLWYN, Ulric, "Usage et maîtrise de la langue dans tous les cours", in *Pédagogie collégiale*, vol. 2, N ^{O} 4, 1989, p. 12-18.

[68] PALKIEWICZ, Jan, *Méthode générale de pensée et d'action responsable*, Diagram distributed at the Colloque pédagogique of the cégep de Limoilou, January 1989.

[69] ARNAUDIN, Mary W, MINTZES, J J, DUNN, C S., SHAFER, T H., "Conception Mapping in College Science Teaching. A Learning Method that can Improve Student Comprehension and Retention of Material ", in *Journal of College Science Teaching*, vol. 14, nº 2, 1984.

These operations will, in varying degree, be completed by rational thought: to analyze, infer, deduce, and generalize. They will be finalized in the schematization stage when the student will organize the basic units of the schema so it reflects the global structure of the text.

Student proposals made during the schematizing process are good illustrations of the preceding assertions. We can generally hear them discussing among themselves the nuances in the thinking of the author, the scope of such or such segment of text. They frequently check their comprehension of preceding paragraphs, and control the value of the links in the process of schematization. Their questions to the professor about the contents are systematically very abundant and very specific. To such an extent that, moderating a schematization session in a classroom of thirty-five students leaves very little time for the professor to take a breather. All of which attests to a consistent and intense intellectual activity. Schematization cannot coexist with cerebral passivity. "Is not learning the result of the mental activity of the learner"? (Saint-Onge). The results of this activity are proportional to the effort invested!

A professor of building mechanics used to use a thirty-page text to explain the principles of steam production from combustion engines. He would invest eight hours of teaching so his students could achieve satisfactory learning. Today, he invests four hours and his students manufacture a schema on the contents. He is very satisfied with the results: "Instead of my explanations in front of the class, I now guide the process by which they learn to learn"

A precious evaluation tool for the professor

The activity of schematization, as an exercise of the mind in action, provides the professor with golden opportunities for an effective intervention. The multiple questions from the students enable him to intervene on the contents and even more so, on the process. Upon seeing the schema, the identification of erroneous notions, inadequate hierarchical organizations or unperceived links becomes easy. For example, the treatment of "judicial" in Myriam's production indicates that a whole section of the text being studied was not understood. The student conjured away the role played by institutions in ideological practices. With this in hand, the professor knows where he needs to intervene to re-orientate the learning. The observation of significant errors may even indicate the lack of mastery of certain skills and facilitate the adoption of corrective measures.

Training in concept schematization

The work of Myriam is a success even though it is her first schematization experience. To work from a perspective of success and positive reinforcement, it is however necessary *to train* the students in the accomplishment of such a task. The ulterior transfer of this strategy to other subjects of thought will be facilitated by it. The experience and documentation relating to this strategy suggest several rules.

- To familiarize the students with the analysis of various types of schemas, by using structuring diagrams that will be studied later. To have the class react to these schemas, examine their legibility and symbols so that students understand the correspondence between ideas conveyed in the schema and its form.
- To show the execution of a schema based on the process, its description and the resolution of the difficulties and ambiguities of data processing. To execute several schemas with the group rather than provide finished schemas; the important thing at this stage is not

performance, but the process and its full comprehension by the students; the exemplary treatment of the difficulties and their resolution must make it possible for the students to recognize rules transferable to future and autonomous activities.

- To initiate gradually. To start with the schematization of short proposals, then paragraphs, eventually to move on to vaster and more complex sets; frequent and brief schematization activities can be introduced: the recall of what was seen in the previous course, the "creation" of a difficult concept, the synthesis of a recently covered lesson, the extraction of key ideas from a discussion, a short text, etc. Arnaudin[70] suggests twenty-minute meetings completed by short works at home (for example, the revision of notes taken in class). This work can relate to specific conceptualization tasks relative to the preparation of a broader learning process and a higher taxonomic level.
- To demonstrate that the production of a schema can take many forms. There is not only one schema, but several forms based on the specific understanding of the author, and this multiplicity is compatible with the stringency required in the representation. It reflects the creativity specific to any authentic intellectual process and there is as such no reason to be astonished by the plurality of the schemas originating from a same informational content.
- To regard the production of schemas by students as preferred times for intervention and formative evaluation. Not to hesitate to intervene on specific operations of thinking, to suggest new paths. For example to insist on the need for the student to use all possible classifications, all the conceptual regroupings suggested or allowed. To frequently activate metacognitive processes to help transform operations into durable skills, thus facilitating the reinvestment of acquisitions with a thorough comprehension of the processes involved in the task.
- To actively encourage student motivation; an important task like the one accomplished by Myriam requires the stimulating presence of the professor. The students cannot yet manage the experiments on their own, at least initially. In this spirit, it is desirable to propose high objectives; however with the understanding that support provided by the professor is equivalent to the degree of difficulty: the more the task requires energy, the more it is necessary to offer support and encouragement.

2.3 Limits to schematization by students

At the end of the production, students achieved the conceptual acquisition of information, the preliminary stage for acceding to higher levels of learning. Although this stage prepares adequately for certain tasks, it is not enough to guarantee the harmonization of the knowledge or critical thinking. Syntheses still need to be done and we need to evaluate the information received, integrate it into the totality of what is already known. The difficulty of the students in transferring acquisitions from their schema into everyday practice clearly points to these limitations.

[70] ARNAUDIN, Mary W, MINTZES, J J, DUNN, C.S., SHAFER, T H., "Mapping Conception in College Science Teaching. A Learning Method that Can Improve Student Comprehension and Retention of Material ", in *Journal of College Science Teaching*, vol. 14, N ^{O} 2, 1984.

2.36 TEACHING

The roles of the professor are many; the mediation between students and knowledge includes the transmission of information. The goals sought, the time available and the degree of novelty of the contents, all require that the professor transmit information. Here again, schemas can be useful in the structuring of information.

2.3

2.3 The concept of "preliminary structuring"

The concept of preliminary structuring was popularized by Ausubel[71] with the expression "*advanced organizer*". This preliminary structuring is a conceptual model presented to the students at the start of the study of a new subject matter. It serves as a support for a presentation of the contents in the form of lecture. It is constructed around the key concepts or the major proposals of a discipline or a field of study. It makes it possible for the students to position a field of knowledge in a "cerebral chart". As the latter acquire new knowledge, it is positioned within the structuring schema or used to complete it. An example of such a schema can be found in "the stages of moral judgment".

Mayer[72] and Ausubel showed that the use of these conceptual models as explanatory material helps the student structure information through the construction of mental models. The use of these schemas seems to decrease the retention of "word for word" while increasing the assimilation of information, in the long run.

A professor of geodesy declared recently that his teaching on demarcation based on the Civil Code had been facilitated by the use of schematization of information in the code. The logic of legal conventions thus became obvious for his students. A content badly digested in previous years became "tasty and easily digested " using this strategy.

The use of the schema in a teaching strategy can play several roles: support a lecture, be used as guide for the study of certain concepts and a specific task, as a comparative model, etc.

The learning in question must be meaningful, the learner must integrate the new knowledge into his cognitive structure. The preliminary structuring must generate the student's mental activity. This schema is constructed so that the most general ideas of the discipline are presented first, followed gradually by the specific ideas. It must include the essential parts of the cognitive system of which it is the subject, as well as the major relations between these parts. Its use is that of a progressive revealing where the parts of the system of knowledge are successively deepened and integrated. It is what Ausubel calls the principle of "progressive differentiation".

---

[71] AUSUBEL, D. P., NOVAK, J D., HANESISN, H., *Educational Psychology: a Cognitive View*, 2nd ED, N*ew York*, Holt, Rinehart and Winston, 1978.
NOVAK, Joseph D, *A Theory of Education*, Ithaca, Cornell University Press.
NOVAK, J, Gowin, B, *Learning How To Learn*, New York, Cambridge University Press.
NOVAK, Joseph D, "Applying Psychology and Philosophy to the Improvement of Laboratory Teaching", in *The American Biology Professor*, vol. 41, nº 8, 1979.
NOVAK, Joseph D, "Learning Theory Applied to the Biology Classroom", in *The American Biology Professor*, vol. 42, nº 5, 1980.
NOVAK, Joseph D., "Applying Learning Psychology and Philosophy of Science to Biology Teaching", in *The American Biology Professor*, vol. 43, nº 1, 1981.

[72] MAYER, Richard E, "Models for Understanding", in *Review of Educational Research*, vol. 59, nº 1, 1989, p. 43-64.

Ausubel underlines the need for what he calls "integrating reconciliation", an activity conducted by the professor to facilitate the anchoring of new cognitive acquisitions to prior knowledge. It constitutes the overall interventions carried out to facilitate the establishment of links between the system and knowledge familiar to the learner: questions, putting into context, analogies, comparative models, etc.

2.37 Pedagogical use of the schemas

So far, we have considered the schemas constructed exclusively by students and the professor as learning strategies or a strategy for explaining information. The use of schemas is not restricted to rigid forms. There are several applications. Some are appropriate for the initiation of students, others presuppose that students are familiar with their use. Here are a few:

- The presentation of a schema that must be completed to facilitate the taking of course notes: the professor provides the structure and the students complete the schema. A presentation thus provides structure for the student. This activity also maintains the student's interest.
- An observation grid from observations taken in the field.
- The manufacture of a schema as the basis for a group discussion: the exchanges which it generates create a dynamic starting point.
- The collective manufacturing of a schema to prepare an examination or one's own test. The professor provides a list of concepts and the students complete the network by listing the links. Such an exercise can be corrected quickly and effectively.
- The manufacture of a semantic chart for the exploration of attributes of a concept.
- Presentation of core information which one completes as a way of exploring a given field or as a collective reflection. It can be used to take stock of what the students already know on a given content.
- The manufacture of a schema as a plan for a presentation or a text.
- The manufacture of a schema as a summary: the level of complexity of the schema is determined by the number of concepts to process.
- The manufacture of a schema "to chart" and illustrate a process completed in the resolution of a problem (mathematical demonstration).

2.38 To conclude

The schematization of concepts is not a panacea for learning problems. The experimenters are however unanimous that it is a powerful working tool. Its applications are many. Its virtue lies in the obligation it places on the user to process the information according to structures. In this respect, it figures prominently in the repertory of cognitive strategies of a cégep student.

Section V
Additional resources

Resource 1
Learner-centered principles: Guidelines for school redesign and reform

Translated from Réginald Grégoire Inc., July 1995 [73]
Translated with permission

General outline:

- **Background**
- **Learner-centered psychological principles**

- Metacognitive and cognitive factors
- Affective factors
- Developmental factors
- Personal and social factors
- Individual differences

- **Impact of school redesign and reform**

- Instruction
- Curriculum
- Assessment of learning
- Instructional management
- Teacher education
- Parent and community involvement
- Policies implications for learner-centered school design

- **Applying the learner-centered principles and their implications to issues in the assessment of student achievement.**

  - Emerging learner-centered principles of assessment

BACKGROUND

Throughout its history, psychology has provided vital information for a concrete definition of schooling through its research and theories on the nature, learning and development of the human being. It has been particularly productive in the last ten years thanks to the results of relevant research in education. Greater understanding of our thought processes and memory as well as our cognitive and motivational processes

[73] Translated from GRÉGOIRE, Réginald. (July 1995). *Principes centrés sur l'apprenant ou l'apprenante. Des orientations pour une redéfinition et une réforme de l'école*, [http://www.fse.ulaval.ca/fac/tact/fr/html/principe.html]

can contribute directly to the improvement of teaching, learning and the whole enterprise of schooling. At the same time, educators concerned with the increasing problems linked to school dropout, low level of academic achievement as regards basic subject matter and other indicators of school failure are arguing for more learner-centered models of schooling. Such models attend to the diversity among students and use it enrich learning and produce results within the context of current school reform.

The following principles, which are consistent with more than a century of research on teaching and learning, are widely shared and implicitly recognized in several excellent school programs. They also integrate the research and practices in various areas of psychology, including clinical, developmental, experimental, social, organizational, community, educational and school psychology, as well as the field of education, sociology, anthropology and philosophy. In addition, these principles reflect conventional and scientific wisdom. They comprise not only systematically researched and evolving learner-centered principles that can lead to positive mental health and more effective functioning of our students, their teachers and the systems that serve them.

Learner-centered psychological principles and a systems perspective for incorporating them are necessary components of a new design for schooling. The systems perspective must focus on human functions at multiple levels of the educational system (learning, teaching, evaluating and management). From this perspective, educational practice will improve only when the educational system is designed with the primary focus on the learner. Psychologists, in collaboration with educators, can help decide how to best apply sound psychological principles in the redesign of America's schools. A new and exciting vision of schooling, and psychology's role in this vision, can then emerge.

Our immediate goal in offering these learner-centered psychological principles is to provide guidelines that can contribute to current educational reform and school redesign efforts and thus help meet the nation's educational goals. Through dialogue with concerned groups of educators, researchers and policy makers, these principles can evolve further to contribute not only to a new design for America's schools, but also to a society committed to lifelong learning, healthy human development and productivity. In developing these principles, psychology – together with other disciplines – can offer a unique contribution to the betterment of America's schools and the enhancement of the nation's vital human resources.

LEARNER-CENTERED PSYCHOLOGICAL PRINCIPLES

The following 12 psychological principles pertain to the ***learner*** and the ***learning process***. They focus on psychological factors that are primarily internal to the learner while recognizing external environments or contextual factors that interact with these internal factors. These principles also attempt to deal holistically with learners in the context or real-world learning situations. Thus, they must be understood as an organized set of principles and not be treated in isolation. The ten first principles subdivide into those referring to *metacognitive and cognitive, affective, developmental*, and *social* factors and issues. Two final principles cut across the prior principles and focus on what psychologists know about *individual differences*. Finally, the principles are intended to apply to all learners, beginning with preschoolers.

Metacognitive and cognitive factors

FIRST PRINCIPLE: THE NATURE OF THE LEARNING PROCESS

Learning is the natural pursuit of personally meaningful goals, and it is active volitional, and internally mediated; it is a process of discovering and constructing meaning from information and experience, filtered through the learner's unique perceptions, thoughts and

feelings.

SECOND PRINCIPLE: GOALS OF THE LEARNING PROCESS

The learner seeks to create meaningful, coherent representations of knowledge regardless of the quantity and quality of data available.

THIRD PRINCIPLE: THE CONSTRUCTION OF KNOWLEDGE

The learner links new information with existing and future-oriented knowledge in uniquely meaningful ways.

FOURTH PRINCIPLE: HIGHER-ORDER THINKING

Higher-order strategies for 'thinking about thinking' – for overseeing and monitoring mental operations – facilitate creative and critical thinking and the development of expertise.

Affective factors

FIFTH PRINCIPLE: MOTIVATIONAL INFLUENCES ON LEARNING

The depth and breadth of information processed, and what and how much is learned and remembered, are influenced by:

a) Self-awareness and beliefs about personal control, competence, and ability;
b) Clarity and saliency of personal values, interests, and goals;
c) Personal expectations for success or failure;
d) Affect, emotion, and general states of mind; and
e) The resulting motivation to learn.

SIXTH PRINCIPLE: INTRINSIC MOTIVATION TO LEARN

Individuals are naturally curious and enjoy learning, but intense negative cognitions and emotions (e.g., feeling insecure, worrying about failure, being self-conscious or shy, and fearing corporal punishment, ridicule, or stigmatizing labels) thwart this enthusiasm.

SEVENTH PRINCIPLE: CARACTÉRISTICS OF MOTIVATION-ENHANCING LEARNING TASKS

Curiosity, creativity, and higher-order thinking are stimulated by relevant, authentic learning tasks of optimal difficulty and novelty for each student.

DEVELOPMENTAL FACTORS

EIGHTH PRINCIPLE: DEVELOPMENTAL CONSTRAINTS AND OPPORTUNITIES

Individuals progress through stages of physical, intellectual, emotional, and social development that are a function of unique genetic and environmental factors.

PERSONAL AND SOCIAL FACTORS

NINTH PRINCIPLE: SOCIAL AND CULTURAL DIVERSITY

Learning is facilitated by social interactions and communication with others in a flexible, diverse (in age, culture, family background, etc.), and adaptive instructional settings.

TENTH PRINCIPLE: SOCIAL ACCEPTANCE, SELF-ESTEEM AND LEARNING

Learning and self-esteem are heightened when individuals are in respectful and caring relationships with others who see their potential, genuinely appreciate their unique talents, and accept them as individuals.

INDIVIDUAL DIFFERENCES

ELEVENTH PRINCIPLE: INDIVIDUAL DIFFERENCES IN LEARNING

Although basic principles of learning, motivation and effective instruction apply to all learners (regardless of ethnicity, race, gender, physical ability, religion, or socioeconomic status), learners have different capabilities and preferences for learning modes and strategies. These differences are a function of environment (what is learned and communicated in different cultures or other social groups) and heredity (what occurs naturally as a function of genes).

The same basic principles of learning, motivation, and effective instruction apply to all learners. However, individuals are born with and develop unique capabilities and talents and have acquired through learning and social acculturation different preferences for how they like to learn and the pace at which they learn. Also, student differences and curricular and environmental conditions are key factors that greatly affect learning outcomes. Understanding and valuing cultural differences and the cultural contexts in which learners develop enhances the possibilities for designing and implementing learning environments that are optimal for all students.

TWELFTH PRINCIPLE: COGNITIVE FILTERS

Personal beliefs, thoughts, and understandings resulting from prior learning and interpretations become the individual's basis for constructing reality and interpreting life experiences.

IMPLICATIONS FOR SCHOOL REDESIGN AND REFORM

The foregoing principles have implications for educational practices in the areas of instruction, curriculum, assessment, instructional management, teacher education, parent and community roles, and educational policy. Some of these implications are listed in the following sections to provide examples that are consistent with the learner-centered principles. They are intended to stimulate further thinking, discussion, and elaboration of ideas toward developing new designs for education.

INSTRUCTION

The characteristics of effective instruction

CURRICULUM

The characteristics of effective curricula

EVALUATION OF LEARNING

The characteristics of effective assessment

INSTRUCTIONAL MANAGEMENT

The characteristics of effective schools and classrooms

The characteristics of effective learning environments

TEACHER EDUCATION

The characteristics of effective teacher education programs

PARENT AND COMMUNITY INVOLVEMENT

POLICY IMPLICATIONS FOR LEARNER-CENTERED SCHOOL DESIGN

The characteristics of these policies

APPLYING LEARNER –CENTERED PRINCIPLES AND THEIR IMPLICATIONS TO ISSUES IN THE ASSESSMENT OF STUDENT ACHIEVEMENT

EMERGING LEARNER-CENTERED PRINCIPLES OF ASSESSMENT

To find out more: consult the following site:

http://www.fse.ulaval.ca/fac/tact/fr/html/principle.html

Resource 2
Practical implications of cognitive theories[74]

To adopt cognitive theory is to build one's teaching practice on the following assertion:

> "Learners are not simply passive recipients of information; they actively construct their own understanding."

The learner is at centre stage. The instructor becomes a facilitator of learning rather than someone who delivers information. This perspective on learning contrasts sharply with models that imply that learners 'get the point' as long as the instructor provides an appropriate stimulus. Cognitive psychology says that the learner plays a critical role in determining what he gets out of instruction.

As instructors, we may provide the same information to several students but we cannot always predict how a student will interpret or use the information. To illustrate this dilemma, consider what comes to mind when you hear the word cardinal. Some individuals think of baseball, some of numbers, some of the Roman Catholic Church, some of the color red. Some even think of sin; it all depends on background and current mindset. As a teacher, my goal is that when I say the word cardinal, everyone in the class makes the same association. It has been shown (Naveh-Benjamin, McKeachie, lin, and Tucker, 1986) that students who make the same connections and use the same content-organization patterns as the instructor do best on standard measures of learning, no matter how they start out organizing or associating content. This change in the conception of what happens during learning makes big differences.

REDEFINING THE STUDENT ROLE

Many students are under the impression that their task in class is passively to absorb what the teacher says in lecture, what is in the textbook, what they see in lab, and what they practice in homework. They are often unaware that what they think they absorb, read, see, or learn from practice may not be what the instructor intends. Their understanding of all these things is strongly influenced by a whole array of variables: their prior knowledge, their interpretation of what is important, the frequency with which they test themselves and their understanding, their perspectives on how all this relates to future use, and so on. Whether they realize it or not, and whether they like it or not, what they learn depends on who they are, where they have been, and what they do. Thus there is no absolute truth; even the initial intake of

[74] SVINICKI, Marilla, *Practical Implications of Cognitive Theories*, New Directions for Teaching and Learning, no 45, spring 1991. Marilla Svinicki is a director at the Center for Teaching Effectiveness, University of Texas, Austin.

information is subject to idiosyncratic interpretation. Scholars in the field of communication have long maintained that both the receiver and the medium are part of the message.

To be most effective, learners must become aware of how their own biases and behaviours filter the information they receive. They must also take a developmental step forward in their understanding of the epistemology of knowledge. They must come to understand that there are multiple ways of interpreting reality. In one cognitive-development model (Perry, 1981), this movement from a dualistic view of the world ("Truth is truth") to one of multiplicity. ('Truth is subject to interpretation"} carries with it a necessary change in one's view of oneself and in what one does during learning is the change from lower cognitive levels (memorization and simple translation of authoritative sources) to higher levels (analysis, evaluation and acceptance of personal responsibility for one's choices).

REDEFINING THE INSTRUCTOR ROLE

For the instructor's role, the first implication of shifting to a cognitive perspective is that neither the teacher nor the content is at the centre of the learning universe. Instructors become facilitators of learning. What we say is not necessarily what students get, unless we are very careful and deliberate about how it is presented. Information is easily garbled in transmission. Our job becomes one of minimizing the noise in the transmission, so that all the listeners (learners) interpret our statements in the same way, or in as close an approximation as possible, and store information in long-term memory so that they can retrieve it in the future. Better yet, we hope to convey the message in such a way that the learner can retrieve it without our intervention when the occasion demands. We do this by careful attention to how the content is structured, how it is sequenced, what examples and activities we use, how we respond to initial learning attempts, and an array of other instructional strategies.

A second implication for the instructor's role is that we are freed from our “Atlas complex" (Finkel and Monk, 1983). The weight of the world of learning does not rest on our shoulders alone; that responsibility is shared with students. They are the ones who must do the learning. They select the learning strategies, monitor their own comprehension, and chart their own course. What we do is help them understand the tools they need for success and arrange the environment to make success possible.

These are difficult adjustments for teacher and student alike but, in the end, students are better off. Someone will not always be there to decide for them what should and should not be learned, how to interpret new information, or what to believe. Those choices eventually fall to the learners. The college

years are none too soon for learners to become self-sufficient.

IMPLICATIONS FOR TEACHING

From the cognitive perspective, teachers are faced with two tasks: First, we must organize the course and its content in a way consistent with what we believe about how learning takes place, paying attention to structure sequence, examples, and activities. Second, and simultaneously, we must help students learn how to learn content, a step in sophistication above the mere learning of content itself. Let us examine how these two tasks are translated into action. Here are six principles drawn from cognitive theory, along with some implications for teaching.

PRINCIPLE 1 : If information is to be learned, it must first be recognized as important.

Implication: the more learner's attention is effectively directed toward what is to be learned (that is, toward critical concepts and major ideas), the higher die probability of learning.

It is easy to see this phenomenon in operation. Consider the way textbooks are structured. Important concepts are highlighted in bold or italic type. This draws the learner's eye immediately to those words, and they are interpreted as important. A lecturer does the same thing by writing a word on the board or putting up an overhead transparency. The lecturer can also highlight concepts by using an outline on the board, indicating the major components of the lecture. Verbal cues, such as `the next main point is... ." or vocal cues, such as slowing down perceptibly when emphasizing some idea, or repeating something important, can be used as highlighting. Phrasing an idea as a question is another way of drawing attention, by making it stand out from the background. In discussion cases, instructors draw attention to main ideas by writing them on the board, repeating them, incorporating them into a summary, or reacting favourably when they are raised by students.

Likewise, students need to learn to recognize the clues that help them identify what is important. This may be what students mean when they say they have learned to 'psych out' the instructor. They learn to pick up clues, however subtle, that the instructor uses to denote the relative importance of material. Eventually, as students become more knowledgeable about the content itself; they can use that knowledge to help determine the importance of new information, without the need for external clues. As noted in the previous chapter, this is one of the differences between the ease of learning in an advanced course and in an introductory course. Without extensive background in a field, all content appears important, and students struggle to master everything. As they learn more, they develop a feeling for what is critical in the discipline. An instructor can do a lot to assist students in recognizing how the discipline determines what is important, by making such discriminations explicit in class. It cannot be accomplished in one class alone. Over the space of several classes, however, students can become more efficient in discriminating the critical features that make ideas important for a field.

PRINCIPLE 2: During learning, learners act on information in ways that make it more meaningful.

Implication: both instructor and student should use examples, images, elaborations and connections to prior knowledge to increase the meaningfulness of information.

It is natural, in the flow of conversation, to cite examples, evoke images through metaphors and analogies, and translate abstractions into concrete instances for ease of understanding. Most instructors use these devices regularly in explaining content. All these devices depend heavily on students' prior knowledge and experience. An example does not clarify a concept if the student has no experience of that example. Saying that a phratz works just like a klogue does not help if you do not know how a klogue works in the first place. Thus it becomes important for an instructor to know students and their backgrounds and to use that knowledge in the selection of activities and examples for use in class.

Students should be encouraged to make their own connections between what is being studied in one class and what they have learned in previous classes or in other settings. For example, students can create personal bibliographies of texts and readings from other courses that are related to the content at hand and then use those materials to supplement assigned readings. Many instructors have students scan the news media for examples related to class concepts. Students can learn to use vivid images and other elaboration strategies, as described in the previous chapter, if the instructor allows time during class for such activities. Instructors can also counsel students to incorporate this practice of making content meaningful into their regular study procedures. An instructor who finds a student having difficulty creating class notes can suggest alternatives to make notes more meaningful. For example, class notes do not have to be exclusively in prose format; sketches and other visual stimuli can serve as helpful elaborations on a basic text. The common thread in these examples is to encourage students to make connections between what they know and what they are learning.

PRINCIPLE 3: Learners store information in long-term memory in an organized fashion related to an existing understanding of the world.

Implication: the instructor can facilitate the organization of this new material by providing an structure or organization of the information and, more particularly, by providing students with a structuring they are familiar with, or by encouraging students to create such structures or such an organization; students actually learn best under the latter conditions.

This principle is at the heart of the cognitive view of learning. We learn and remember information because we act on it in such a way as to fit it into an organized pattern based on our worldview. Instructors

who present course content in an organized fashion are increasing the probability that students will use that organizational structure to understand and store the content. For a single lecture this means having a clear outline displaying that outline as a guide to listening; and maintaining an orderly sequence of concepts and examples. Earlier, we saw that the diagram enhances attention; here, we see it playing an additional role in learning.

In the overall course structure, organization means relating logical units of content to one another and building in a regular pattern toward the ultimate goal of the course. The pattern can be chronological, comparative, hierarchical, or representative of any other relationship. Whatever pattern is chosen, it should be made explicit to students.

The second part of the concept of organization is also important: relating the organizational structure to students' existing worldviews. In the absence of a clearly delineated structure from the instructor, students will impose on content the organization most closely related to their current view of things. Thus, in a history course the organizational structure that students are most likely to choose is chronological; it is what they are used to and is often their sole view of how history is organized. If the instructor's thinking is organized around some other structure, such as causes and effects, and if that organization is not made clear to students, then class content may appear very confused and disorganized. In the sciences, the influence of students' pre-existing organizations shows up in commonsense misconceptions about the causes of everyday phenomena. These misconceptions can create some bizarre attempts to explain events and are often very difficult to overcome.

In the absence of a pre-existing organization or one provided by the instructor, students are likely to revert to rote memorization, a technique that may work in the short run but will eventually reach its capacity limit and produce failure. When new information is not or cannot be tied to old, students may easily encapsulate it as separate from everything else. This makes the new information hard to learn and easy to forget. It pays for the instructor to be aware of students' backgrounds and predispositions and to clarify which patterns of organizing the content are acceptable and which may be in conflict with those of the students.

Students can learn to recognize or create structures to facilitate their own learning. As noted earlier, one measure of students' grasp of content is the degree to which each student's conceptual map of the content organization matches the instructor's map. Getting in the habit of outlining readings and lecture notes, creating tree diagrams showing the relationships of concepts to one another, and learning other

forms of content organization are tools students can use to make learning more efficient. By introducing students to these tools an instructor helps them move closer to self-sufficiency.

PRINCIPLE 4: Learners continually check their understanding, which results in refinement and revision of what is retained.

Implication: providing the students with opportunities for checking and evaluating their learning are ways of supporting learning,

Think about how you read different types of material. If you are truly attending the material and not just skimming it, you constantly monitor your reading. Sometimes you are brought up short when you find a sentence that seems incongruent with your understanding of what has gone before. At that point, you back up and reread it, to find the cause of the discrepancy. That practice illustrates comprehension monitoring: an important executive process in learning. In reading, we have the luxury of interrupting ourselves to check on understanding, going back and replaying what we have just read to look for inconsistencies. In classes, however, most students do not have that opportunity, because they are not in control of the pace of the class; the lecturer controls the pace. If they do not understand something or think they hear a discrepancy few students have sufficient self-confidence to interrupt and ask for clarification. Their usual response is to write down verbatim what is being said and go back and check it later. Poorer students, especially, may have given up the monitoring process altogether, in favour of just getting it all down. They feel they do not have time to think during class.

The instructor could give them this time. Most instructors pause periodically and ask for questions. They may rarely hear the important questions however, because they seldom wait long enough for students to formulate them, it takes a few seconds to mentally look back over what has just been said and check for understanding. It takes a few more seconds to create a question that will make sense to others and not make the questioner look foolish. That is already six seconds, at the minimum and only for really good students who have been able to keep up. Most instructors have difficulty waiting even a few seconds before moving on; no wonder we seldom get questions. Students do not understand everything perfectly - they are just not fast enough to recognize what they do not understand and then ask.

Once instructors become aware of the need for and difficulty of monitoring they can take steps to help students engage in this important strategy. For example, as just discussed, learning to wait a while longer after inviting questions (known as wait time} can be a big help. An even more significant step is to be very directive about checking understanding. For example, many instructors insert pauses in their

lectures during which students are instructed to write a one or two-sentence summary of what has just been discussed. One or two of these summaries are then reviewed out loud for accuracy. This practice gets students in the habit of thinking in terms of major ideas and summaries and periodically checking their understanding. Students who have not been able to produce the summaries become aware immediately that they did not understand something and can either ask questions or note their confusion for future questioning or remediation. This practice also provides the instructor with feedback on students' understanding before it is too late to do something about it - These are only a few examples of how monitoring can be built into a class. For additional ideas an monitoring, consult Cross and Angelo (1988)
Students can be encouraged to engage in their own comprehension monitoring. One particularly popular strategy is to set aside a column on each sheet of class notes. In this column, the student records monitoring questions as the lecture or class period proceeds, noting confusions, connections with other ideas, potential test questions, and so on. The mere presence of this column reminds the student to monitor thinking as the class proceeds.

Comprehension monitoring shows up most frequently in suggestions about reading. Students are encouraged to preview the reading and to record questions that they expect to be answered in the material. As they read, the need to answer those questions prompts students to process the reading at a deeper level than mere repetition of the words on the page, getting in the habit of pausing at each break in the reading (say, where headings appear) and asking questions about what went before is another way of tracking comprehension.

There we many possibilities for increasing awareness of understanding and its failure. Most important is to ensure that students see the need to pay attention to their attention.

PRINCIPLE 5: Transfer of learning to new contexts is not automatic, but results from exposure to multiple applications.

Implication: provision must be made during initial learning to ensure this transfer.

To believe that one exposure to material is sufficient to allow a student to use that information forever in the future is naive. To believe that a beginning student is able to see all the potential uses for what he is learning is also naive. Indeed, much of their schooling seems to have convinced students of the independence of content, what they learn in math class has no relationship to what they learn in English or chemistry and vice versa. As instructors, however, we know that knowledge is related and that using it in

different contexts makes it more meaningful and more easily remembered. We also know that, in the real world, students are unlikely to encounter situations for using their new knowledge that are exactly the same as what they experience in the classroom. They must learn how to take what they learn and transfer it.

We can help them make that transfer by building it in from the very start. Our greatest tool for facilitating transfer is incorporating a wide range of application opportunities and settings into the learning situation. The more (and the more different) situations in which students see a concept applied, the better they will be able to use what they have learned in the future. It will no longer be tied to a single context.

An instructor can facilitate transfer through simple repetition. The more we use a skill or concept, the more automatic its use becomes, until we hardly have to think about it at all. It is the rare student who can learn to solve a complex type of math problem after trying only one example. It takes many hours of practice to become proficient at most things, to reach a level of automaticity. Why should intellectual skills be any different?

A final facilitator of transfer involves getting students to abstract the principle from the practice. If students can articulate the steps they are taking to solve problems, or if they can extract an underlying concept from a set of examples, then they will be more likely to use that abstraction in a different context. This is known as de-contextualizing and is the more complex complement of "automatism." In practice, an instructor can have students talk to one another about the processes they are going through to solve problems. In so doing, they become aware of the steps they use (Lochhead and Whimbey, 1987). This awareness is then translated into increased ability to apply the sane steps, now detached from their original context, in a new situation.

PRINCIPLE 6: Learning is facilitated when learners are aware of their learning strategies and monitor their use.

Implication: the instructor should help students learn how to translate these strategies into action at appropriate points in their learning.

These six principles discuss instructors' activities in the context of teaching the content of specific courses, but they also apply to the content of knowing how to learn (learning strategies. too, can be viewed

as content to be learned). Attention should be drawn to learning strategies. Their use should be monitored, and their transfer to new settings should be ensured. When an instructor takes on the task of teaching both the content of the discipline and the content of learning strategies within the same course, he will enrich students in both areas. There are several objectives and instructional methods for teaching the content of learning strategies.

Students need to know what cognitive learning strategies are. Most students are not aware of the different strategies available to them. An instructor can illustrate the strategies that exist by taking every opportunity to point out the process of learning as it occurs. For example, to help students learn to recognize the clues that indicate the importance of material and the degree of attention it should receive, the instruction during the first few class periods, can explain the purpose of using visuals or the blackboard to highlight important concepts, as well as how the textbook uses similar techniques to highlight important ideas. After the first lecture, the instructor can illustrate these strategies by taking a few minutes to show students how the organization of the lecture should be reflected in their notes and to remind them of how that organization was made explicit during the lecture itself. At the beginning of the next class period, students can be asked to recall the main points of the previous class and to discuss how the organizational structure helped them remember the main ideas. These we only a few examples of how an instructor can make learning strategies explicit in the context of the course itself. These strategies are applicable to listening in class, reading the textbook, preparing for exams, monitoring understanding, managing time and a whole range of other general learning situations that students may never have analyzed in just this way.

Students need to know when to use the strategies they have learned. This is a more difficult task for the instructor because much of the decision about when to use a strategy depends on students' individual needs as well as on the context. Nevertheless, the instructor helps by providing information on what alternative strategies are available and how they can be applied to different situations. He or she can model different strategies while answering questions or solving problems raised in class. Too often, students believe that the instructor immediately knows all the answers to all questions asked; they do not realize that instructors frequently have to think through new problem and new questions, just as students do. Taking the opportunity to work on new problems with students and show how to approach a new situation serves as a good model for students to understand that different problems require different approaches.

Another opportunity to help students understand the situational contexts of learning strategies occurs when students come individually for assistance. Talking with them about the strategies they have tried, as well as working with them to develop new strategies for attacking new problems, can make them aware of the need to vary the solution with the situation.

Students need to know how to adapt their strategies to new situations.

This is really the problem of transfer, taken one step further. Just as we need to vary contexts in order for students to transfer content skills to new situations, we need to vary learning situations in order to show how strategies apply to different situations. Something that would be particularly helpful in this task is cooperation among instructors in different areas. This has been referred to as the metacurriculum (Weinstein, (1982): the idea of incorporating instruction in learning strategies into all courses, regardless of content. If instructors in chemistry used the same terms for learning strategies that instructors in history used, students would begin to de-contextualize those strategies and then be more likely to apply them to French as well. They may not work identically in all fields, but many of the concepts can be applied across disciplines, or at least in similar contexts (for example, in all language classes or in all fact-based classes).

SUMMARY

There is a great deal of intuitive appeal to the cognitive approach to teaching. It echoes our own experience as learners and is easy to understand. Applying the approach is very difficult, however, because we must give up our illusion of control. That change shakes the foundation of content as the primary focus of our teaching. We are then faced with the task of adapting to the needs of learners, a varied and unpredictable group. Fortunately if we accept the precepts of cognitive theory that learning is active, not passive, we will help to develop more productive learners who will function effectively and independently in the uncertainties of the future. Isn't that what it means to be a teacher?

REFERENCES

Cross, K.P. and Angelo, T. Classroom Assessment Techniques: A. Handbook for Faculty, Ann Arbor, Michigan, National Center for Research on Improving Postsecondary Teaching and Learning, 1988.

Finkel, D.L. and Monk G.S. "Teachers and Learning Groups: Dissolving the Atlas Complex." In C. Bouton and R.Y. Garth (eds), *Learning in Groups: New Directions for Teaching and Learning*, no. 14 San Francisco: Jossey-Bass, 1983.

Lochhead, J. ad Whimbey, A. "Teaching Analytical Reasoning Trough Thinking Aloud Pair Problem Solving". In J.E. Stice (ed), *Developing Critical Thinking and Problem-Solving Abilities. New Directions for Teaching and Learning*, no. 30, San Francisco,: Jossey-Bass, 1987.

Naveh-Benjamin, M., McKeachie, W.J. Lin, Y.G., and Tucker, D.G. "Inferring Students' Cognitive Structures and Their Development Using the 'Ordered Tree Technique" in *Journal of Educational Psychology*, 1986, 78, 130-140.

Perry, W.G. *Growth in the Making of Meaning*, in A.W. Chickering (ed), *The Modern American College*, San Francisco: Jossey-Bass, 1981.

Westein, C.E. A Metacurriculum for Remediating Learning-Strategies Deficits in Academically Underprepared Students. In L. Noel and R. Levitz (eds), *How to Succeed with Academically Underprepared Students*. Iowa City, Iowa: American College Testing Service, National Center for Advancing Educational Practice, 1982.

Resource 3

Vision of learners in the 21st century

Learner-centered perspectives

Modern communication and information technologies are having an increasing impact on learning - how we learn, where we learn, when we learn, what we learn, what learning resources we have, and why we learn.

It is important that our learning systems be guided by a vision of learners and the communities to which they belong and which they are helping to create.

To open a discussion on these questions, SchoolNet held a workshop on April 19-21, 1996 at the CIBC Leadership Centre in King City, Ontario. There were over 30 participants from across Canada, from schools, governments, universities and a variety of organizations that took part in the pan-Canadian event.

The purpose of the workshop was to develop a Vision Statement on learners in the 21st Century: what assumptions we should make about the characteristics and beliefs of a successful learner and a supportive learning system, the pressures and tensions involved in developing such a system, the core values that we should hold about learning, some of the possible directions we can follow. This statement is a work tool at the disposal of those in educational environments who are curious about the changes in learning conditions caused by developments in technology and the need to adequately respond to these changes.

The vision statement is addressed to learners, educators, parents, policy makers, business and community leaders, politicians and all who are interested in the important subject of learners, learning, and learning communities.

This Vision Statement is intended to invite participation in building a vision of the learner – the assumptions we are making, the core values guiding our vision, and the elements of this vision. Participation is also invited on the problems we must address and the alternative directions we might take.

To read the article : http://www.fse.ulaval.ca/fac/tact/fr/html/vision2.html

Resource 4

The operationalization of a socioconstructivist problem-based learning model at collegial level

By Ouellet, Lise and Guilbert, Louise

Abstract

Working with students in physical rehabilitation techniques, we have applied a problem-based learning approach at the college level. This research is introspective: the principal researcher -- who is also the teacher -- attempts to render the principles that guide her both explicit and formal. Our purpose is to understand (1) how a theoretical model can be transformed in the face of restrictions in the field, and (2) what principles, drawn from our practical knowledge, influence the application of this approach in a truly scholastic milieu. After reflecting on our actions, we attempted to reconstitute, with content analysis, the principles which guided us in our practice. This was done on the basis of our field data (course preparation, anecdotal diaries, explanatory meetings). It would appear that the theoretical model must become increasingly operational, translating into initial principles, and that in fact the principles derived from previous practical knowledge rank before theoretical principles. This reflection and this formalization of principles should be of help in successfully implementing a new teaching model.

For more information, please refer to the following article:
http://www.acelf.ca/revue/XXV1/articles/rxxv1-04.html

Mediagraphy
Learning models

1. BRETON, J. (1991). La schématisation des concepts: un instrument de développement des habiletés conceptuelles au collégial. Pédagogie Collégiale, 4(3), 18-23.

2. DELACOTE, G. (1996). Savoir apprendre les nouvelles méthodes. Paris : Éditions Odile Jacob.

3. HENEMAND, J. G. D. (1996). *Devenir enseignant*, D'une expérience de survie à la maîtrise d'une pratique professionnelle. Montréal: Éditions Logiques.

4. JONES, B. F., PIERCE, J., & HUNTER, B. (1988). Teaching Students to Construct Graphic Representations. Educational Leadership, 46(4), 20-25.

5. JONNAERT, P. V. B. C. (1999). Créer des conditions d'apprentissage: un cadre de référence socioconstructiviste pour une formation didactique des enseignants. Paris/Bruxelles: Coll. Perspectives en éducation, De Boeck Université.

6. LAFORTUNE, L. D. C. (2001). Accompagnement socioconstructiviste. Pour s'approprier une réforme en éducation. Sainte-Foy: Presses de l'Université du Québec.

7. LASNIER, F. (2000). Réussir la formation par compétences. Montréal: Guérin.

8. LEGENDRE, A.-M. (2001). Favoriser l'émergence de changements en matière d'évaluation des apprentissages. Vie Pédagogique, 120 (September-October), 15-19.

9. OUELLET, Y. (1997). Un cadre de référence en enseignement stratégique. Vie Pédagogique, 104 (September-October), 4-10.

10. PÔLE DE L'EST et al. (1996). Processus de planification d'un cours centré sur le développement d'une compétence. Rimouski: Délégation collégiale Performa.

11. RAYMOND, D. (2001). Qu'est-ce qu'apprendre? ou Apprendre, oui mais. Sherbrooke: MIPEC, Performa, Université de Sherbrooke.

12. RAYMOND, D. (2001). Qu'est-ce qu'enseigner? ou enseigner, oui mais... Sherbrooke: MIPEC, Performa, Université de Sherbrooke.

13. SIROIS, G. (2002). Tableau des intelligences multiples.

14. SVINICKI, M. (1991). Practical Implications of Cognitives Theories, traduit et adapté par Claude Gagnon. New Directions for Teaching and Learning, 45.

15. TARDIF, N. (1999). Pour réussir la mise en oeuvre des programmes d'études: un processus continu. *Vie Pédagogique*, 110 (February, March), 37-41.

Internet sites visited

1. AMIGUES, René. *Enseignement-apprentissage*, [http://www.aix-mrs.iufm.fr/services/communication/publications/vocabulaire/n1/amigues1/index.html]

2. CARON, Rosaire. (juin 2001). http://www.bibl.ulaval.ca./doelec/citedoce.html

3. CHABOT, André. (2001). *Une situation problème, le quoi et le pourquoi*, http://www.cegep-chicoutimi.qc.ca/reflets/refletsv10n1/retour

4. Commission scolaire de Laval. *Situations-problèmes*, http://www.cslaval.qc.ca/tic/francais/grel/sitprobl.htm,

5. DELIRE, Jean. *Banque d'outils méthodologiques: la situation problème*, [http://www.agers.cfwb.be/pedag/ressources/fcc/doc011/Situprob.doc]

6. DISCAS, HENRI Jacques CORMIER Jocelyne. (2001). *Les principles didactiques et leurs impacts*, http://discas.educ.infinit.net/Cadreref/Documents/principlesImpacts.html

7. GIORDAN, André. *Enseigner n'est pas apprendre*, http://www.unige.ch/fapse/SSE/teachers/giordan/LDES/infos/publi/articles/ens.html

8. GIORDAN, André. *Le modèle allostérique et les théories contemporaines sur l'apprentissage*, http://www.unige.ch/fapse/SSE/teachers/giordan/LDES/rech/allostr/th.app/th_app.html,

9. GRÉGOIRE, Réginald. (juillet 1995). *Principles centrés sur l'apprenant ou l'apprenante. Des orientations pour une redéfinition et une réforme de l'école*, http://www.fse.ulaval.ca/fac/tact/fr/html/principle.html

10. INTIME (Integrating New Technologies Into the Methods of Education), University of Northern Iowa's College of Education. (2001). *Les étudiants au centre de leur propre apprentissage*, http://www.intime.uni.edu/model/French_Model/center_of_learning_files/principles.html

11. Lalthoum, Saadani Bertrand-Gastaldy Suzanne. (2000). *Cartes Conceptuelles et Thésaurus : Essai de Comparaison Entre Deux Modèles de Représentation Issus de Différentes Traditions Disciplinaires*, http://www.slis.ualberta.ca/cais2000/saadani.htm#Top

12. Le Trait d'union Express, Université de Sherbrooke Service de soutien à l'enseignement. (13 décembre 2001). *L'apprentissage par problèmes*, http://www.usherb.ca/sse/tu/decembre/app.htm

13. MEIRIEU, Philippe. *Guide méthodologique pour l'élaboration d'une situation problème*, [http://perso.wanadoo.fr/philippe.martin/MERIEU.htm]

14. OUELLET, Lise GUILBERT Louise. (printemps-été 1997). *L'opérationnalisation d'un modèle socioconstructiviste d'apprentissage par problèmes en milieu collégial,* [http://www.acelf.ca/revue/XXV1/articles/rxxv1-04.html]

15. PERRENOUD, Philippe. (1997). *De nouvelles compétences professionnelles pour enseigner l'école primaire*, [http://www.offratel.nc/magui/ORGANSR.htm]

16. Productions *TACT*. (3 décembre 1996). *Apprendre au 21e siècle*, http://www.fse.ulaval.ca/fac/tact/fr/html/vision2.html

17. Scott, P. H. et al. *L'enseignement pour un changement conceptuel : une revue des stratégies*, [http://sir.univ-lyon2.fr/gric-coast/ICPE/francais/partieC/C5.html]

18. TACT, Université Laval. *Liste des Post-its*, http://www.tact.fse.ulaval.ca/fr/html/cours/coursgcr/post/postit23.htm

19. Vuillemin, Lionel. *Enseigner et apprendre ŕ cerveau total*
La technologie des préférences cérébrales, appliquée à la formation, http://www.herrmann-france.com/formation.html