



Basic skills and the psychology of education: highly topical issues

In their introduction to the collective publication entitled [Apprendre et faire apprendre](#) (*Learning and teaching*), Etienne Bourgeois and Gaëtane Chapelle (2005) remind us that, since the beginning of the XXth century, scientific psychologists have been attempting to shed light on the mechanisms and conditions for "learning and teaching", which define teaching methods and teaching practices.

These theories conflict with an indisputable observation: too many children are still struggling and bored at school. They give up and drop out of the school system without having acquired the skills that teachers have been trying to pass on to them.

What role could psychology play? Looking at the recent research carried out on the psychology of education applied to learning at the primary level, one can list various experiments concerning both the didactics of maths and the didactics of one's primary language.

The approach adopted in this summary was to select some of the most recent experiments carried out from a psychological perspective, in connection with basic skills, and to report on the conclusions proposed by the researchers.

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A few keys for deciphering this inventory

The basic skills

To understand the concept of basic skills here, we need to take a closer look at the French system of cycles and more specifically 'cycle II', or the basic skills cycle, which concerns the final year of nursery school (aged 5 to 6) and the first two years of elementary school. By basic skills we essentially mean "reading, writing and counting" (BOEN, [2002](#) and [2006](#)). These skills must lead to the acquisition, at the end of the educational phase, of a certain command of language, mathematics, foreign languages, musical education, the visual arts, physical and sporting education, and result in a capacity to live together and discover the world.

A significant number of articles published in 2005 and 2006 look at the transition between the final phases of nursery school (aged 5 to 6) and the first year of elementary school with regard to educational practices and cognitive development at nursery school and their impact on learning at elementary school.

The psychology of education

In his foreword to the work *La psychologie de l'éducation* (the psychology of education), M. Fayol suggests that we should consider that "the psychology of education covers all studies of psychological structures and mechanisms likely to intervene in an educational situation". He also draws attention to the dominant role played by the cognitive approach in recent studies ([Foulin & Mouchon](#), 2005).

The study of basic skills looks at the concepts of memory, motivation, knowledge, capacities, strategies, contexts, differences and differentiation. Research is to an increasing extent being carried out on the basis of learning situations, i.e. reading-comprehension, written production and numerical learning.

For M. Fayol, the act of learning is very logically linked to a spirit and a level of intelligence. The curricula must enable the acquisition and implementation of learning strategies, which make the individual relatively independent in his appropriation of new knowledge and know-how: "Merely defining and imposing 'traditional' instruction is no longer sufficient".

The current research work is underpinned by certain "historical" theories, by referring to them, refuting them, developing them or implementing them (at the end of this document there is a selection of works published or re-published in 2005 or 2006). A brief reminder of these theories is moreover proposed by E. Bourgeois in the book mentioned above (entitled [Apprendre et faire apprendre](#) (*Learning and teaching*)).

- **Functionalism** considers that learning involves transformation at two levels: that of action and that of thought; pupils act and then reason on the basis of this action. The learning process should be perceived by the learner as a functional activity, which has meaning and will be useful.
- **Behaviourism** considers that learning is determined by the environment, which is a source of stimuli or behavioural reinforcement. This trend influenced educational practices such as programmed learning, education through objectives and the education of command.
- **Gestalt psychology**, or the psychology of form, considers that human behaviour is not mechanically conditioned, but that, to the contrary, man's mental activity relates to his environment. This trend will influence all the models related to a learner's thought processes and notably cognitive psychology. The information processing theories, applied to educational theories, see the learner as a processor who receives, selects, memorises and communicates information. Cognitive psychology research in education will therefore study these information processing operations on the basis of the type of learning required.
- **Constructivism**, defined by J. Piaget as an alternative approach positioned between behaviourism and *Gestalt psychology*, sees learning as a process via which knowledge mobilised by the subject in a given situation is transformed during interaction with his environment. When the initial mobilised knowledge is no longer sufficient for processing the information with which the subject is confronted, a cognitive conflict or imbalance ensues.
- The **theory of social learning**, proposed by A. Bandura, is an offshoot of the behaviourist model and attributes the changes in individuals' behaviour to two principal causes: observation and imitation. Bandura develops, for example, the concept of direct reinforcement (of behaviour) when a person observes a model, imitates the model and is then reinforced or punished for this behaviour. He speaks of vicarious reinforcement when a person anticipates a reward by aiming to reproduce the behaviour for which another person has been rewarded. This type of behaviour is important as it introduces the concept of personal efficiency, and the subject's confidence in his capacity to respond or to act correctly and, consequently, his motivation.
- Neo-piagetians show that pupils required to carry out tasks in order to solve problems learn faster and more sustainably if these tasks involve interaction with peers. The socio-constructivist (co-operative learning) approach is looked at here.
- **Lev Vygotski** is a very important figure in this inventory of learning theories. For a long time unknown, (as he was banned in translation), he criticises the Piagetian approach for its lack of social and cultural dimension. For Vygotski, "all learning involves the usage of aids, equipment or symbols. Yet these aids are necessarily influenced by culture, and convey the schools of thought and values of the society that produces them and uses them". His theories have received a great deal of attention; to such an extent, in fact, that we speak of a "Neo-Vygostkian" trend. As an extension of this approach, one should mention the trend linked to **Jerome Bruner**. He focuses on the principle that learning is not an individual process but a collective one, based on collective resources. In the field, this trend is reflected through systems underpinned by interaction between peers, tutoring (cognitive supervision) and the development of communities of practices.

Cognitive development and its evolution

The work entitled *Psychologie du développement* (Psychology of development) (2004) by L. Chanquoy and I. Negro offers the remaining material necessary for understanding the experiments recently carried out (presented below) on the development of memory and language. The authors describe the essential development stages prior to the age of two, and they also look at the learning of written language and the formal approach adopted for learning to read.

The research carried out in the psychology of education generally focuses more on memory (what types of memory?) and knowledge (declarative or procedural), on the usage of semantic information (production and understanding of oral or written information) and secondary information (representations, memories or past experiences).

Issue number 152 of the *Revue française de pédagogie* (French educational review) (2005) suggests themes for analysis about the relationship between cognitive sciences, learning and teaching approaches. In their article "*Du cheminement aux cheminements*" (Developmental evolution) (Bastien & Bastien-Toniazzo, 2005), C. Bastien and M. Bastien-Toniazzo re-trace the changes in the psychology of cognitive development, which has moved away from an approach focusing on the acquisition of knowledge towards an approach focusing on procedures and the treatment of individual situations.

As a result, a large proportion of the work carried out on basic skills and the acquisition of basic knowledge concentrates on these developments. What may be seen by some merely as a broad variety of approach options, may be interpreted by others as factors of complication (for the child and/or the teacher).

These themes were studied with regard to both learning arithmetic and learning to read. In his contribution, entitled "*Les différences de cheminement dans l'apprentissage*" (the different evolutions in learning) (in Bourgeois & Chapelle, 2006) J. Lautrey makes a connection between these numerous (but not countless) procedures and the educational approaches conceivable.

Learning situations

In order to make this research on the school system and learning more available and visible, the Ministry of Research launched an ACI (Concerted Incentive Plan) in 2000, entitled "*École et sciences cognitives*" (School and cognitive sciences). Among the initiatives implemented was the creation of European or international networks designed to structure the research carried out on "language phenomena".

In addition to the experiments or analyses carried out on specific learning situations (which we will outline below), various articles report on broader studies with regard to cognitive issues, such as learning contexts, inter-relationships and motivation etc. Our summary is in fact nothing more than a sweep through the relatively abundant literature available, providing several examples to illustrate the problems treated. As these articles were generally reports on experiments, we have provided an overall résumé of the objectives of each study, the methodology used and the first results observed. Most of the work aims to define ways of improving the acquisition of basic skills, such as, for example, teaching methods, different working postures (for the teacher and/or the pupils) or a different organisation of the tasks to be carried out. The various situations presented below refer to the social psychology: relationships between peers, self-concept, tutoring and the role of the teacher in the teacher/pupil relationship.

From the pupils' perspective

I. Hay is interested in **self-concept**. His most recent work reports on the "exploring self-concept program" which he implemented and tested on 280 11 year-old pupils at a Brisbane mixed school (Hay, 2005). Having evaluated the pupil's self-concept, a test, based on the Marsh questionnaire of 1988 (the SDQ-1) was given to pupils, which included non-academic content such as physical prowess, peer interactions, physical appearance and relationships with parents etc. It also included three academic areas: reading, maths and general schooling. At the end of the experiment, i.e. at the end of ten weeks, a new self-concept evaluation was carried out. By comparing the pre- and post- test results one was able to detect various improvements (physical appearance and schooling in general) in academic areas as opposed to non-academic areas. For Hay, **the discussion and thought-processes** required of the pupils with regard to the teaching that they receive, the educational context and their capacity to solve problems **help them to choose strategies** for improving their perception of their social environment and well-being.

In addition to the observational studies, there are other situational analyses that look at the concept of **pupils who analyse** or at least "reflect". Lena Green (South Africa) shows the possibility and appeal of making pupils reflect on what they are doing at each stage of learning to read. She proposes a series of issues such as 'noticing', 'naming', 'comparing', 'categorizing', 'connecting', 'generalizing' and 'remembering'. Pupils are consequently involved in an approach which is shared with the teacher and other pupils, and in which both sides respect the other role: "*The educator possesses cultural knowledge that must be mediated to the learners*" (Green, 2005).

The impact of inter-peer relationships is also the subject of much research, most notably with regard to the concept of camaraderie. P. Kutnick and A. Kington (G.-B.) were keen to evaluate **the impact of friendships** between pupils (often linked to background factors) on the perception that pupils may have about their performances in this context, the quality of their class-work and on co-operation levels between peers. They deduce that teachers should attempt to better understand this camaraderie in order to draw conclusions with regard to a pupil's potential (Kutnick & Kington, 2005).

It is not just a case, therefore, of making the inter-personal relationship experiments and analyses more detailed. English and New-Zealand researchers are studying the effectiveness that **groupwork** has on the acquisition of basic skills. Through their work on the Spring project (Social pedagogic research into groupwork) their objective was to apply three key principles: adopt a relational approach, study the role of teachers and create conditions favourable for groupwork. Their study, based on a sample of over 500 pupils aged between 8 and 11, shows that groupwork can have a significant impact on class-work, but that habitual working practices hamper this type of approach, and that it would be beneficial to re-think the educational theories and practices that favour the teacher's leader role and individual work (Blatchford & al., 2006).

Going deeper still into the concept of thought and sharing, V. Martel presented a case study on the "*Émergence d'une communauté d'apprentissage en réseau à l'ordre primaire*" (the emergence of a network learning community at primary school level) (Martel, 2005). The methodology used (p. 36) examines the transformation of learning environments by focusing on several learning situations, using and cross-referencing participative observations, interviewing pupils and what the author calls *l'ethnographie des écrits* (processing of written work, whether on paper or virtual). In a section dedicated to data, the author explains the objective of creating a learning community and notably the procedures involved in giving pupils a sense of responsibility in organising their own learning (p. 73). The processing of data on a sample of approximately forty Quebec pupils (at the end of primary school) enabled the author to draw conclusions as to the usefulness of these learning communities, which involved the schools' administrators, teachers and pupils. The skills that were developed in this study were essentially oral but the author notes that this **learning community** could be transformed into a knowledge development community and could be applied to written text practices in order to solve more complex problems.

Motivation

B. Galand coordinated [issue 155](#) of the *Revue française de pédagogie* (French educational review) around motivation at school. In addition to an article introducing the report entitled: "Motivation in a learning situation: the contribution made by the psychology of education", he wrote, in conjunction with Pierre Philippot and Marianne Frenay, an article aimed at identifying the factors that can stimulate pupils' motivation and their adaptation at school. **Multi-level analyses** show that a "control focused structure" has a positive impact on pupil's motivation, whereas a performance based structure has a negative impact and increases the risk of victimisation. Finally, these analyses also show that quality teacher/pupil relationships have a pacifying effect on pupils' aggressiveness (Galand & al., 2006).

In this same issue of the *RFP*, T. Bouffard, C. Vezeau, R. Chouinard and G. Marcotte present an experimental study based on a sample of 958 3rd and 4th year pupils at primary schools in the suburbs of Montreal. In reference to the work carried out by Bandura (still within the context of research into motivation), the authors were keen to gain a better understanding of the **illusion of incompetence** phenomenon. As this can be a contributing factor to a pupil dropping out, they believe that, whilst the detection criteria used in this study make it possible to pinpoint pupils suffering from this illusion (less motivated but more importantly negative with regard to improvement), it is difficult to identify the factors that boost the development of this phenomenon, and they stress that this identification is necessary if the phenomenon is to be countered (Bouffard & al., 2006).

From the teachers' perspective

S. Havu-Nuutinen presents a study on the **conceptual change process** that takes place in 6 year-old Finnish children during science lessons on the concepts of floating and sinking. The author observed the changes in **representation** during the theoretical teaching phase and in what way discussion could induce cognitive changes during the experimental and exploratory phases of the lessons. Based on a **qualitative analysis of the verbal data**, changes in children's' perceptions were mainly epistemological and pupils' theories improved from a scientific perspective. As a result, Havu-Nuutinen deduced that a pupil/teacher interaction oriented towards concepts is more likely to improve pupils' cognitive progress and their cognitive skills with regard to the concept of floating (Havu-Nuutinen, 2005).

Is this primarily a Scandinavian concern? In the *Scandinavian journal of educational research*, M. Sandstrom-Kjellin describes a **dyadic teacher/pupil model** in a traditional teaching situation. She tests various situations, in which 1) the teacher evaluates the learner according to his presuppositions (previous experience); 2) the teacher constructs skills by providing the learner with indices prior to evaluation; 3) the teacher has not necessarily predicted the answer that he will be given but he is

genuinely interested in it. This latter situation is the one that guarantees the best **cognitive development** conditions for the pupil ([Sandstrom-Kjellin](#), 2005)

More recently still (July 2006), the same journal published an article on changes in teaching practices, which have moved away from an individualised teaching approach towards a personalised teaching approach. This article follows the central theme covered by the issue "Is there a Nordic school model?" and looks back at the individualisation trends that prevailed in the Scandinavian countries in the XXth century. The authors, who graduated from different Scandinavian universities, subsequently carry out an analysis by country, in order to show, on the basis of the developments seen over the last twenty years, similarities or differences in the approaches adopted in the different countries. **For the Nordic countries, it is not a question of whether or not to implement an individualisation approach, it is merely a question of what type of individualisation should be implemented** ([Carlgren & al.](#), 2006).

Another recurring problem: the **questioning**. Who asks the questions? The teacher, the pupil, the two together, the group? When should the questions be asked? Can the pupil question the teacher? Is the question only evaluative or is it a medium for discussion and advancing knowledge? O. Maulini has published several articles on this subject. Having analysed the question/answer trends that naturally occur between teachers and pupils (from simple dialogue through to solving problems), he concludes that schools could combine theory and practice, and could take the time to discuss problems and issues so that knowledge is constructed rather than just merely transmitted ([Maulini](#), 2005).

□ And also

- The "[les effets des dimensions conatives en éducation](#) (the effects of the conative dimensions in education) conference (personality, motivation, self-esteem and social skills)", on June 7 and 8, 2006, University of Nantes.
- Haahr Jens Henrik, Kibak Nielsen Thomas, Eggert Hansen Martin & Teglgard Jakobsen Søren ([2005](#)). *Explaining student performance: evidence from the international PISA, TIMSS and PIRLS surveys*. Copenhagen : Danish Technological Institute.

Learning one's primary language: writing and reading-comprehension

Implicit and explicit writing skills

The psycho-educationalist M.-F. Morin (who is currently carrying out research on the learning of spelling during the first cycle of primary school and more specifically on implicit and explicit writing skills) has published, in partnership with Isabelle Montésinos-Gelet, the results of a study on *Les habiletés phonogrammiques en écriture à la maternelle : Comparaison de deux contextes francophones différents France-Québec* (Phonogrammic writing skills at nursery school: a comparison of the two different French speaking environments i.e. France & Quebec) ([Morin & Montésinos-Gelet](#), 2005). French pupils seem better prepared for entry into the primary system (development of literacy). This difference with the Quebec children should be associated with the French educational policies (emphasis placed on the understanding of the alphabetical text, schooling at the age of 3). This focus on the copying of words, phrases, texts (see the document proposed to school teachers in France, entitled [Le langage à l'école maternelle](#), [language at nursery school] 2006) enables the child to have control over the letters that he wishes to produce. The authors nevertheless recommend that these initial results should be associated with nursery school teaching practices and that the teaching of reading skills should be extended until the end of the first year at primary school.

One of the debates on learning to write at nursery school focuses on the **differentiation** to be made between drawing, graphics and writing (see the text by [D. Dumont](#) on the site Bien(!)Lire).

L. Rieben, L. Ntamakiliro, B. Gonthier & M. Fayol published a report on a study carried out on 145 5 year-old children. The objective of their experiment was to measure the **impact that learning to write early has on reading (understanding) and spelling**: knowledge of letters, detection of phonemes, the writing of words and spelling. The discussion that followed this experiment was based on the impact of such and such a practice on reading and/or writing skills. It seems that a method used on its own, even if it results in a certain level of reading or writing, does not produce the same results as a combination of practices such as, in this case "the invention of writing" followed by individually explained corrections ([Rieben & al.](#), 2005).

□ And also

Analyses that report on the relationships between written production and working memory:

- Alamargot Denis, Lambert Éric & Chanquoy Lucile ([2005](#)). « La production écrite et ses relations avec la mémoire ». *Approche neuropsychologique des acquisitions de l'enfant*, n° 17, p. 41-46.
- Olive Thierry & Piolat Annie ([2005](#)). « Le rôle de la mémoire de travail dans la production écrite de texte ». *Psychologie française*, vol. 50, n° 3, p. 373-390.

The role of the teacher

In order to add to these theories, M. Fayol and J. Morais, stress, in the conclusion of their contribution to the ONL Seminars on "Reading and learning to read" ([Fayol & Morais](#), 2004), the important role played by teaching in contributing to the progress made by pupils in understanding. They refer to a study carried out on pupils in the final phases of nursery school (i.e. aged 5 to 6) and the first year infants at nursery school. "[The] **time dedicated to the development of phonological awareness, notably on the former category [i.e. aged 5 to 6], [...] better explanation of the code and more intensive teaching with regard to understanding at the first-year infant stage**" resulted in greater progress shown by children in experimental groups (the teachers of which had followed a specific course).

Learning to read

By reading the themes proposed at the coming conference, entitled "*Approche cognitive de l'apprentissage de la langue écrite*" ("*The cognitive learning approach for written language*") ([University Rennes 2, October 2006](#)), together with the list of speakers invited, one is given an overview of the approaches adopted in Europe about learning to read: identification of written words (A. Content, laboratory of experimental psychology, Brussels), understanding of words or written texts (J. Oakhill,

Laboratory of Experimental Psychology, Brighton), production of graphic movements (P. Zesiger, Faculty of psychology and educational sciences in Geneva) and orthographical production (M. Fayol, LAPSCO).

As part of the ACI entitled "*École et sciences cognitives*" (The school system and cognitive sciences) (see above), Jean-Louis Paour implemented the research programme "*Fonctionnement cognitif et pratiques pédagogiques : prédire, observer et intervenir en GS pour prévenir les difficultés d'apprentissage au CP*" (Cognitive functioning and educational practices: predicting, observing and intervening at nursery school [ages 5 to 6] to prevent learning difficulties in first-year infants), (end of contract report: [Paour et al., 2005](#)). This research study combined three approaches: the evaluation of pupils' performances, implementing of cognitive education programmes and observation of teaching practices. A sample of 400 nursery school pupils in the final phases, i.e. aged 5 to 6 (in priority education networks), was monitored and evaluated on three different occasions in order to study "*the development of 5 group factors: attention, planning, sequential processes, simultaneous processes and basic knowledge*". Three **metaphonological training** programmes (work on phonemes, syllables and rhymes etc.) were implemented on a group of 100 pupils, then these pupils were evaluated. The results obtained show the genuine efficiency of these metaphonological training programmes in terms of school results and more specifically their impact on reading results and their relative superiority in relation to other types of training.

Language skills, coding and meaning

The psychology department at the University of Lancaster is interested in the atypical development of language skills. It is notably studying the difficulties encountered by children whose vocabulary level is right for their age but who have understanding and narrative formulation difficulties. The latest articles focus on the cognitive learning approach and more specifically the capacity to remember, the evaluation of reading-comprehension, the differences between pupils and their semantic deficiencies.

K. Cain, in association with other researchers, has published, over the last two years, the results of work carried out on the comprehension strategies of readers aged between 8 and 10. This involved, for example, the understanding of a text in which the conjunctions have been removed, the capacity to find the right conjunction (Cain & al., [2005](#)) and the capacity to use the context to understand narrative texts (Cain & al., [2004b](#)). Pupils with reading difficulties do not necessarily have vocabulary problems, but they seem to implement comprehension strategies later. Furthermore, when it comes to reading slightly longer texts, the results highlight the role of the working memory and the role of the initial understanding directives (Cain & al., [2004a](#)).

The research carried out draws attention to the fact that learning to read is not solely a question of decoding, it is also underpinned by factors of culture and language, a question of meaning. In his article "*Access to basic reading skills and discovery of the written culture*", G. Chauveau suggests several characteristics that indicate successful teaching of reading: co-operative (educator-, parent- or teacher- learner interaction), cultural, conceptual (stimulating thought and intelligence) and interactionist (children looking for codes as well as for meaning) ([Chauveau, 2004](#)).

Learning context

In April 2005, the Department of Evaluation and Prospection published the results of a [reduced number experiment](#) carried out on approximately one hundred elementary school classes. The experiments were carried out on classes, which had been **reduced** to 8-12 pupils. From a teaching practice perspective, there were no significant changes, the practices remained just as varied, whether the numbers had been reduced or not. As far as pupils' performances were concerned, the benefits and differences did not seem significant with regard to the recognition of words and phonology, and the complex processing that one could observe after five months as first-year infants seem to be smoothed out at elementary school. Numerous researchers in the psychology of education (mentioned throughout our newsletter) participated in this experiment. Other observations have subsequently been published such as those by J. Ecallé, A. Magnan and F. Gibert ([2006](#)). In this article, the authors cross-referenced the "class size" and "presence of allophone pupils or pupils with language difficulties" criteria and analysed the connections between "class size", "procedures used" and "pupil commitment". Whilst confirming the weak impact of a change in numbers on pupils' basic performances in reading and spelling, they deduced from their analyses that children in difficulty make better progress in a small **class group**.

The concept of "**peer effect**" is especially present in Anglo-Saxon journals. The article by A. Ammermueller and J.-S. Pischke is interesting for numerous reasons: it focuses on statistical analysis techniques often used for this type of problem (calculating regression and correlations between context variables, i.e. the demographic, social and cultural environment, and factors likely to influence learning); and it is based around reading ability evaluations in six countries, i.e. Germany, France, Iceland, Norway, Holland and Sweden. According to the calculation mode, the "peer effects" are strongest in France and Holland, and at their lowest in Norway, Iceland and Germany. The effects are high in Sweden but should be taken in moderation in view of the educational approaches that differ from school to school ([Ammermueller & Pischke, 2006](#)).

Whatever the psychological approach adopted for trying to understand the learning-to-read process, it is important to be aware of any developments in the teaching of this subject and the related debates. One should also look at the impacts of research on changes in teaching practices. Two documents by the National Reading Observatory (ONL - *Observatoire National de la Lecture*) provide a good summary of this line of questioning:

- *L'évolution de l'enseignement de la lecture en France, depuis dix ans (The evolution of teaching methods applied to reading in France over the last ten years)* (ONL, [2004](#)). This document assembles the proceedings of the ONL's seminar (entitled "*Journées de l'Observatoire*"), and a report is accessible via the site [Bien\(!\)Lire](#).
- *L'apprentissage de la lecture à l'école primaire (Learning to read at primary school)*, a report produced by the Education Authority at the French National Ministry of Education (ONL, [2005](#)).

□ And also

- [La lecture en débat](#) (Reading as part of a debate), dossier d'Éducation et devenir (81 p., format PDF) ;
- The site [Bien\(!\)Lire](#) and notably the page entitled "[Apprendre à lire à l'école primaire](#)" (Learning to read at primary school), which follows on from the Department of School Teaching's seminar in March 2006.
- Demont Elisabeth, Gombert Jean-Émile (to appear). « Relations, conscience phonologique et apprentissage de la lecture : peut-on sortir de la relation circulaire ? ». In E. Demont, J.-É. Gombert, & M.-N. Metz Lutz (Eds). *Acquisition du langage : approche intégrée*. Éditions Solal.

- Amongst the latest documents produced by M. Fayol and A. Miret, we should mention "*Écrire, orthographier et rédiger des textes*" (Writing, spelling and producing texts) ([Fayol et Miret, 2005](#)), which reports on an experiment concerning the impact of 'CE2' (elementary school – grade 3) pupils' graphic control on their performances in dictation.
- Morais José ([2005](#)). « Les apprentissages et processus cognitifs de base ». In Ministère de l'enseignement de la communauté francophone de Belgique. *Lecture : apprentissage et citoyenneté*, p. 535.

Learning numbers

In the preface of the book *Enseignement et apprentissage des mathématiques (Teaching and learning maths)* ([Crahay & al., 2005](#)), M. Fayol stresses the fact that most books looking at arithmetical development generally focus on the issue from the perspective of the determining factors for development, i.e.: capacities, processing speed, working memory etc. In this work, E. De Corte and L. Verschaffel create a conceptual framework for a stimulating environment. Other contributions look at the development of the first arithmetical skills (the base ten system, adding and subtracting, problem solving etc) and propose educational systems based on cognitive development models.

Understanding

It is not possible to separate reading-comprehension from the solving of arithmetical problems. This aspect is the subject of numerous studies by researchers who are closely involved with cognitive psychology. One can read, for example, the longitudinal report on approximately one hundred 1st and 2nd year Finnish primary school pupils in which M.-K. Lerkkanen, H. Rasku-Puttonen, K. Aunola and J.-E. Nurmi observe a **correlation between maths performances and the level of reading-comprehension** ([Lerkkanen & al., 2005](#)).

Certain research studies focus on the questions asked prior to verbally announcing the arithmetical problem and the expected performance. This issue is recurring and has mobilised researchers such as P. Barrouillet, M. Fayol and C. Thévenot whose approach in an article published in *L'Année psychologique (The Psychological year - 2004)* entitled "Représentation mentale et procédures de résolution de problèmes arithmétiques : **L'effet du placement de la question**" (Mental representation and procedures for solving arithmetical problems: effect of questioning) is also adopted in an article soon to be published in the *Quarterly Journal of Experimental Psychology-A* (2006).

Representation of the problem to be solved and strategies adopted

We have seen that there are development difficulties in the learning process and that they can be either genuine difficulties or the result of different strategies. In an article entitled the **difficulties in number conceptualisation** at elementary school, L. Numa-Bocage and C. Larere postulate that certain difficulties in arithmetic cannot be detected through traditional evaluations. They report on an analysis of the procedures implemented by elementary school pupils, in five specific mathematical situations. These situations, presented individually to the pupils at the beginning and end of elementary school, reveal a broad variety of number conceptualisations, and relationships between the mother tongue and these conceptualisations ([Numa-Bocage & Larere, 2006](#)).

They can help the teacher detect how each pupil in his class develops conceptually and help "determine for each pupil the *next development zone* in which he can implement didactic mediation action to prevent or resolve a difficulty". We see the same approach used in the work of Véronique Martel, quoted above (see the 'Learning Situations' section).

In her research on **mental representations of numbers**, C. Thévenot aims to verify the hypothesis according to which the working memory uses different codes (verbal, analogical or visual) for numbers according to the task to be carried out. She then studies the impact of different variables on calculation strategies, i.e. long term memory storage of number facts or algorithmical procedures for solving operations.

The **representation of an arithmetical problem** is one of the analysis themes looked at by R. Brissiaud, who discusses it in a text published on the Café Pédagogique site ([June 2006](#)). This article, which focuses on the opportunity to teach the four operations at elementary school, was subsequently the subject of discussion with maths teachers. These discussions show to what extent the debate on learning (i.e. methods and curricula) is sensitive. It seems, however, that, whatever the approach chosen, i.e. cognitive or didactic, the main aim must be to enable the pupil to "**control, through his senses**, the skills which will be memorised and the methods that will become automatic" (Roland Charnay).

The central issue of this debate is the introduction (or not) of division into number learning at elementary school level, in view of the strategies implemented by pupils when solving **fraction problems**. As part of the ESRC research programme, entitled "Teaching and learning" (see the Research objectives section), the psychology of learning department at Oxford University has recently been working on these **perceptions and strategies**. T. Nunes, P. Bryant, J. Hurry and U. Pretzlik propose, on the department's site, several presentations made in 2005. The last of these, entitled "*Children's insights and strategies in solving fractions problems*" ([Nunes et al., 2005](#)), shows that the concept of division is clearly understood by pupils but that to understand the concept of quotients, pupils (aged 8 to 9) use different strategies. It also shows that discussions both in small groups and with the teacher about these strategies and representations improve the understanding of fractions.

The **proportionality** problem arises at the end of primary school. During the *European society for research in mathematics education* conference, M. Pantziara and D. Pitta-Pantazi reported on the study carried out on approximately one hundred 10 and 11 year-old pupils with regard to the informal strategies that they adopt in solving proportionality problems and their representations of the proportion concept ([Pantziara & Pitta-Pantazi, 2005](#)).

□ And also

- Thévenot, Catherine & Oakhill, Jane ([2005](#)). « The strategic use of alternative representation in arithmetic word problem solving ». *Quarterly Journal of Experimental Psychology*, vol. 58, n°7, p. 1311-1323.
- Marchini, Carlo & Rinaldi, Maria Gabriella ([2005](#)). *Geometrical pre-conceptions of 8 years old pupils*. Congrès CERME4. European Society for Research in Mathematics Education.

Motivation, self-concept and self-evaluation

Psychology and maths researchers at the University of Jyväskylä studied pupil motivation and the correlation with their maths learning performances in the first and second year of primary school. Their primary objective was to **discover if the motivation lasted after primary school**. They consequently carried out a longitudinal study on 196 children born in 1993, evaluated in 1999, 2000 and 2001, and then at their entry into the secondary system. The results show that the performances in maths and motivation in related work form a **cumulative development cycle** during the first two years at primary school. This level of performance and motivation is especially high when the teachers consider that motivation is a major educational objective and transmit this to the children. The authors conclude their analysis by indicating that **the approach adopted by the teachers** with regard to the type of learning (i.e. not resorting to outside justifications, such as academic utility, but aiming to boost pupils' autonomy and their sense of control over the task in hand by focusing on their emotional development) **is important** in the last years of primary school **as it structures pupils** for their entire schooling experience ([Aunola, Leskinen & Nurmi, 2006](#)).

At the [CERME4](#), A. Panaoura and G. Philippou announced the first results of a survey carried out on 126 pupils aged between 8 and 11. Their aim was to study how pupils **represent** their own **performances** when carrying out an exercise (geometry, calculation, etc.), i.e. self esteem, self-learning, motivation, etc.

E. A. Linnenbrink carried out a similar experiment, but with a larger sample (237 pupils), on a whole range of exercises and over a longer period. She focused on the effects of **control and performance objectives** in a given activity and in the **context** of a class-group, but from a critical perspective as to the theories generally proposed on the relationship between personal objectives and group objectives ([Linnenbrink, 2005](#)).

Geometry and cognition

Geometry is another major stage in the learning process. Although beyond the context of basic skills, several studies show the importance of cognitive development in the acquisition of certain geometrical concepts.

The *Annales de didactique et de sciences cognitives* (*The Annals of didactics and cognitive sciences*) propose an article on "*Les conditions cognitives de l'apprentissage de la géométrie*" (*the cognitive conditions of learning geometry*). The author, R. Duval, explains that geometry demands "cognitive articulation of two very different registers of representation: the visualisation of forms to represent space and language, list properties and deduce new ones. Learning difficulties primarily arise from the fact that these two registers are often used in a way that is contrary to their normal cognitive function outside maths". Here we are looking at problems of dimensional deconstruction (shapes already known but to be reconstructed) and discursive capacities: denomination and listing of properties and education ([Duval, 2005](#)).

□ And also

- Nimier Jacques ([2006](#)). "*Camille a la haine et... Léo adore les maths. L'imaginaire dans l'enseignement*" (Camille hates and...Leo adores maths. The role played by imagination in teaching). Aléas éditeur.

To conclude

The analyses mentioned show a broad variety of results, from the observation of fairly insignificant changes in such and such a learning practice or environment to hypotheses that have been the subject of detailed verifications with regard to the progress observed. One should also note the almost permanent presence of a conclusive element, which one can summarise as follows: "it is necessary to carry out other experiments to add to the analysis". Aside from the necessity to justify the continuation of research, this also involves producing a form of research report, which covers the following stages: "*background*" or "*theoretical framework*", study objectives, methodology, results, discussion, experimentation limits and a conclusion. With regard to research in education methodology, one can refer to the VST newsletter of May 2006: "[What is good research in education](#)".

In what way should these research studies be continued?

Between March 2004 and January 2005, the site [VousNousIls](#) proposed a series of articles entitled "[Special edition on applied research](#)", which focused on ten interviews on a variety of themes with teachers/researchers in cognitive psychology or educational sciences. P. Huguet: the influence of context on pupils' performances; J.-P. Astolfi: error, a source of learning; E. Gentaz: tactile learning to read; A. Giordan: creating a desire to learn; A. Florin on schooling prior to the age of three; S. Boimare: fighting the fear of learning; J.-P. Roux: socio-cognitive confrontations; M. Gather-Thurler: modifying the learning cycles; S. Baruk: "Maths must be taught as a living language" and A. Lieury: "Creating links between research and National Education".

In the latter article, A. Lieury had to answer the following question: "Do you have the feeling that this discovery [semantic memory] and those that followed have had concrete applications at school". His response is clear: "*In France, almost none! In the United States and elsewhere, psychology is treated like the other sciences, such as chemistry or biology. The discoveries are therefore immediately applied or, at the very least, experimented with. In France, on this point, there is practically no link between researchers and National Education, which is governed by its own system*". There is no doubt that not everybody will agree with this point of view and A. Lieury tempers his argument by expressing his confidence in the teachers whose individual initiatives offer feedback from the field. This perspective was published (January 2005) prior to the recent debates on basic skills, the educational standards and priority education.

The theme of "the psychology of development and learning in a school situation" is clearly explained in the support document for the [Marcel Crahay course](#) on Geneva University's site. In this document, there are notably two illustrated chapters on learning to read and learning maths.

The National Agency for Research (ANR) issued a project tender in March 2006 on the theme: "[Apprentissages, connaissances et société](#)". (Learning, knowledge and society). Point 4 of this document is entitled "learning, cognition and learning contexts". The ANR's objective with this chapter is to renew systematic and controlled research "in a natural or experimental environment, which could lead to stable and reproducible results". On the basis that learning processes are not invariant or

universal, it recommends that their variability is studied according to the cultural environment: between social groups, for individuals within the same group and for an individual in various situations.

Research objectives

The laboratories working on the psychology of education belong to educational science departments, psychology departments and even bi-disciplinary departments. The research objectives used for this summary were as follows:

- The study of the development of cognitive functions in educational contexts: basic skills, development of knowledge and dysfunctions; representations, evaluations, educational contexts and judgement, study of the psychological effects of educational context, in relation to representations, evaluations and judgement ([LABECD, Nantes](#));
- The study of school contexts, teaching and learning practices, cognitive learning processes; the study of attitudes and behaviour found in social situations ([LSE](#); [Cogni-sciences](#); [laboratoire de psychologie sociale](#), [social psychology laboratory] Grenoble 2);
- The study of the psychology of development, the social ethology of young childhood, psycho-social adaptation to school, social adaptation and success at school, the social construction of the knowledge of numbers, etc. ([Cognitive psychology](#) Bordeaux 2);
- The study of the development of executive functions and cognitive efficiency: the study of cognitive and meta-cognitive factors such as intellectual efficiency, working memory, attention, the flexibility of cognitive procedures or cognitive self-regulation; the study of social representations, and the socio-cognitive and emotional processes ([PsyCLÉ](#); [Laboratory, words and language](#); [Laboratory of social psychology](#), Aix-Marseille 1);
- The study of learning, didactics and cognitive development: memory, attention and perception ([CRPCC](#), Rennes 2);
- The study of the cognitive processes involved in learning: underlying mental processes in the development and functioning of children of pre-school and school age, through a behavioural and neuro-anatomic approach ([UPR/SCLS](#), Strasbourg 1);
- The study of individuals' behaviour in a learning situation (cognitive processes implemented, influence of contexts and of their change with age – and their maladjustment): learning and mobilisation of skills, development of basic skills, one in relation to time estimation exercises and the other in relation number exercises ([LAPSCO](#), Clermont 2);
- The study of the cognitive mechanisms involved in understanding, reasoning, and the acquisition of knowledge, both from a general and developmental perspective (school learning and EIAH) ([CRAC](#), Paris 8);
- The study of cognitive functioning: emergence of the first stages of the acquisition of language in children, the structure of mental representations of numbers, in the solving of problems, strategies implemented etc ([Laboratoire cognition et développement](#) [Cognition and development laboratory] Paris 5);
- The study of man's mental functioning and his capacity to carry out a certain number of complex tasks, such as reading words, understanding text, calculating, reasoning and solving problems, and forming internal representations in accordance with the environmental structure ([LEAD](#), University of Dijon);
- The study of the construction of behavioural organisation, and the principles of change in this organisation during their acquisition, in relation to the organisation of the context in which these acquisitions take form ([Apprentissage et contexte](#) [Learning and context] EHESS);
- The analysis of the cognitive and emotional processes involved in complex activities: the interactive and emotional processes involved in the construction of knowledge, representations of learning and teaching exercises, basic skills (written language) and associated meta-processes ([Psychologie cognitive des conduites complexes](#) [Cognitive psychology of complex exercises] 10).

This list is not exhaustive. It does not cover, for example, certain laboratories that focus on cognitive psychology related to the sciences and information and communication techniques, or social psychology, for which the research themes are not explicitly linked to children, education or school learning. We have also not included studies on problems of dyslexia or developmental difficulties in making simple calculations about the neurosciences or clinical psychology. Finally, other research teams (in educational science) have occasionally been quoted for their inter-disciplinary work.

In Europe, our reading covered:

- The [GIRSEF](#) (Inter-faculty Group of Research on Education and Training Systems) at the Catholic University of Louvain, Belgium;
- The [LAPSE](#) (Laboratory of experimental psychology) and the [UNESCOG](#) (Cognitive neuroscience research unit) at the free University of Brussels, Belgium;
- the [Faculty of Education](#) at the University of Joensuu, Finland;
- the [department of learning and motivation](#) at the University of Jyväskylä, Finland;
- the [Developmental psychology research group](#) at the University of Lancaster, Great Britain;
- the research programme of the [ESRC](#) (Economic and social research council) encompassing the [Oxford Brookes University](#), *Oxford university* and *The Institute of Education of the University of London*, Great Britain;
- the [Cognition and language](#) department at the University of Sussex, Great Britain;
- the [EMACS](#) laboratory (educational measurement and applied cognitive science) at the University of Luxembourg;
- the [Langeveld Institute for research](#) at the university of Utrecht, Holland;
- the ISB ([department of social sciences](#)) at the University of Mälardalen, Sweden.
- The department of [education and educational psychology](#) at the University of Fribourg, Switzerland;
- The department of [psychology and educational sciences](#) at the university of Geneva, Switzerland;
- The Institute of social and educational sciences at the University of Lausanne, Switzerland.

Further afield...

- The [department of psychology](#) at Duke university, Durham, North Carolina;
- The [department of studies on school and social adaptation](#) at the university of Sherbrooke, Quebec.

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