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SCIENCE TEACHING IN THE PRIMARY SCHOOL. A COMPARISON BETWEEN "GOOD PRACTICES" CARRIED OUT IN FRANCE AND IN ITALY IN THE XXITH CENTURY

"La Main à la Pate" (Finger in the pie) is a wide experimental project started in France in 1996, aimed at revolutionizing Science teaching in the primary school. It has deeply influenced the national programs for the primary school proposed by the French Education Ministry in 2002 and recently in 2008. It is a sort of "pedagogical adventure", which poses pupils in a central position and proposes direct experimentation, a strict bonding between science and language, a particular attention to the development of pupils' imagination and creativity, as well as their logical reasoning and utmost attitude.

The same basic principles inspired the Italian project "ISS - Insegnare Scienze Sperimentali" (Teaching Experimental Science): this project was proposed by the Italian Ministry of Research, University and Education (MIUR) in 2005, in collaboration with Science Teachers Associations (DD-SCI, AIF, ANISN) and two Italian Scientific Museums (Milano and Napoli). Now in the Italian Ministry Indications for the Curriculum (2007) and in the practice of many teachers we can find some important reminds to the "philosophy" of the ISS project.

The target is represented by "competence goals", gradually distributed along the different school periods, pursued by: (a) laboratorial didactics (b) context of sense; (c) vertical approach; (d) cross-curricular approach.

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Il Piano Nazionale Insegnare Scienze Sperimentali, ISS Una quinquennale esperienza di innovazione della didattica delle scienze

Già nel 2003 gli esiti comparativamente rovinosi della valutazione internazionale OCSE-PISA per scienze e matematica, ma anche per la lingua, avevano messo in evidenza la sconfortante situazione culturale dei nostri quindicenni e portato, anche se con un certo ritardo, il nostro Ministero della Pubblica Istruzione ad assumere delle iniziative volte a rispondere agli obiettivi fissati nel 2000 dal Consiglio di Lisbona. In quell'occasione la Comunità Europea, infatti, tra gli obiettivi da raggiungere entro il 2010, aveva stabilito quello di "rendere i sistemi di istruzione e formazione dell'UE un punto di riferimento di qualità a livello mondiale".

È in questo quadro che nel 2005 il MIUR accoglie la proposta di un progetto per la formazione degli insegnanti, presentatogli congiuntamente dalle tre Associazioni disciplinari che operano nel nostro Paese (AIF, cioè Associazione per l'insegnamento della Fisica; ANISN, ovvero Associazione Nazionale degli Insegnanti di Scienze Naturali; DD-SCI, cioè Divisione Didattica della Società Chimica Italiana). Il progetto, che fin dalle sue fasi iniziali vedrà anche il coinvolgimento di due importanti Musei (il Museo Nazionale della Scienza e della Tecnologia di Milano e la Città della Scienza di Napoli), formalizzato attraverso un apposito Protocollo di Intesa tra MIUR e i proponenti che ne definisce finalità, modalità di attuazione e struttura operativa, si trasforma ben presto in vero e proprio Piano Nazionale assumendo la denominazione "Insegnare Scienze Sperimentali", in sigla ISS, come viene ormai solitamente indicato.

Il Piano ISS è dunque attivo da cinque anni e possiamo dire che in questo lasso di tempo ha dato vita ad una diffusa ed articolata comunità che ricerca e condivide una metodologia didattica fondata sulla centralità dello studente nel suo proprio processo di formazione scientifica e pratica l'aggiornamento degli insegnanti secondo le tecniche della ricerca-azione e in modo funzionale alla didattica per competenze.

ISS si avvale di una complessa rete di collaborazioni che vede coinvolti il Ministero, gli Uffici Scolastici Regionali, gli istituti scolastici di ogni ordine e grado, gli esperti di didattica delle scienze espressi dalle Associazioni e dalle Università e che si articola a cascata dal livello nazionale a quello regionale e locale.

In verità l'obiettivo fondante del Piano ISS è specificatamente quello di migliorare la professionalità dei docenti della scuola di base, raggiungendoli nel loro stesso ambiente di lavoro e soprattutto proponendo modalità di aggiornamento partecipato attraverso la creazione di una comunità di pratiche tra i docenti dei diversi ordini di scuola. Da qui l'identificazione in ogni Provincia di apposite strutture denominate "presidi territoriali", luoghi attrezzati, generalmente Istituti scolastici, in cui docenti selezionati e formati a livello nazionale si possano incontrare per confrontare le loro esperienze, per elaborare nuove proposte metodologico-didattiche, per organizzare formazione in servizio e per collaborare "tra pari" con i colleghi del territorio desiderosi di innovare la propria didattica passando dalla scuola del programma alla scuola delle competenze verificabili e certificabili. L'obiettivo finale era e dovrebbe ancora essere quello di realizzare, in tempi relativamente brevi, un rinnovamento della didattica delle scienze nella scuola di base, che si riferisce alla fascia di età da 6 a 16 anni, cruciale sia per la formazione di un cittadino moderno e consapevole, sia per porre le basi di qualunque ulteriore approfondimento culturale e professionale.

Il modello formativo del Piano ISS si basa infatti su due principi fondamentali: la centralità dello studente nell'azione didattica e l'apprendimento attraverso l'esperienza diretta dell'incontro con i fenomeni e gli oggetti di studio. La "didattica laboratoriale", intesa come didattica della ricerca aperta al protagonismo degli studenti, costituisce uno strumento di fortissima innovazione che il Piano ISS ha introdotto nella filiera formativa che va dalla Scuola Primaria alla Secondaria di Secondo Grado. Si tratta di una metodologia particolarmente votata a favorire il raggiungimento da parte degli studenti di "traguardi di competenza", gradualmente distribuiti lungo i vari livelli di scolarità.

I principi pedagogici che ispirano il Piano ISS sono chiaramente esposti nelle "Indicazioni per il Curricolo per la scuola dell'infanzia e per il primo ciclo d'istruzione" pubblicate dal MPI (Ministro Fioroni) nel settembre 2007 e sono ormai entrati a far parte della pratica didattica in molte scuole delle varie Regioni.

ISS è dunque testimonianza di scelte importanti e lungimiranti, che dovrebbero venire adeguatamente e costantemente sostenute dal Ministero, ma ciò che conforta è che in tutto questo "non siamo soli": molte caratteristiche del Piano ISS si ritrovano anche nel progetto "La Main à la Pate" che, iniziato in Francia come sperimentazione nella scuola primaria fin dal lontano 1996 e ormai con un'esperienza consolidata, ha rivoluzionato l'insegnamento delle scienze nella scuola primaria di quel Paese influenzandone i Programmi Ministeriali del 2002 e i più recenti del 2008. Il quadro di riferimento francese si è dunque mosso prima di quello italiano, che però si è misurato in modo originale e decisamente più convincente con il problema della verifica dei traguardi di competenza raggiunti dall'allievo per rispondere all'obiettivo sostanziale di cittadinanza e a quello formale della certificazione.

Tutto bene dunque? E allora perché riferendoci all'obiettivo finale abbiamo utilizzato una forma dubitativa : "l'obiettivo finale era e dovrebbe ancora essere"? Spiace dirlo, ma il condizionale è d'obbligo: infatti, malgrado tutti gli aspetti positivi citati fin qui, il Piano Nazionale ISS sta vivendo una fase di crisi per una serie di manovre ministeriali che non sembrano prefigurare alcunchè di buono. Il Comitato Scientifico è stato del tutto esautorato dalle scelte, il "Gruppo di pilotaggio Nazionale", che costituiva l'esecutivo del Comitato Scientifico, ha subito un rimpasto deciso unilateralmente dal MIUR senza che i sottoscrittori del Protocollo di Intesa siano stati interpellati o coinvolti nella decisione e nelle motivazioni ad essa relative. Siamo dunque di fronte alla situazione paradossale di avere a disposizione la comunità di pratiche didattiche in area scientifica più importante ed imponente che sia mai stata istituita in Italia e, allo stesso tempo, alla liquidazione di coloro che detta rete hanno progettato e contribuito a costruire. Il vero interrogativo è ora chi e come si potrà sostenere e diffondere l'innovazione di ISS a fronte degli atti di imperio del MIUR che si accompagnano ai pesantissimi tagli ai fondi e al personale docente (unico Ministero della EU) e alla scarsa considerazione dell'educazione scientifica che la cosiddetta "Riforma" dell'attuale Ministro testimonia quando impone il radicale taglio delle ore di laboratorio? Se sul piano pedagogico a livello internazionale ci troviamo in buona compagnia, su quello della concreta attuazione di ISS nella scuola del nostro Paese ci sentiamo oggi più soli di ieri: per il bene dei nostri studenti c'è solo da augurarsi che non sia veramente così e che il buon senso possa prevalere sulle inqualificabili logiche dei tagli indiscriminati.

Rosarina Carpignano

The Italian project "ISS - Insegnare Scienze Sperimentali" (Teaching Experimental Science) was proposed in order to face the increasing difficulties, evidenced by the OCSE-PISA (Programme for International Student Assessment) survey, in which the Italian students obtained really modest results. The project was proposed by the Italian Ministry of Research, University and Education (MIUR) in 2005, in collaboration with Science Teachers Associations (DD-SCI, AIF, ANISN) and two Italian Scientific Museums ("Museo Nazionale della Scienza e Tecnologia", Milano and "Città della Scienza", Napoli). Now-a-day in the Italian Ministry Indications for the Curriculum (2007) and in the practice of many teachers we can find some important reminds to the "philosophy" of the ISS project.

The ISS project is aimed at providing teacher's education and professional development in order to allow these "school operators" to (i) put pupils in the centre of their didactic action and (ii) lead pupils to learn through the direct experience with both phenomena and objects under investigation. These actions are supported by local units (the so-called *presidi*), composed of trained teachers who can assist the colleagues in selecting the best practices, acquiring new knowledge, skills and competences. The target of the project is represented by "competence goals", gradually distributed along the different school periods, that pupils should reach through a laboratorial didacticts based on specific process indicators.

It is worth noting that world-widely this project is not the only example of good practices in Science teaching: in fact, school performances, according to the OCSE-PISA survey, deteriorated in a large number of Member States, in particular in the scientific area. In order to slow down (and possibly to stop) this negative trend, some actions have been taken, among them the "*La Main à la Pate*" (*Finger in the pie*) project, started in France in 1996 (on the basis of the "*Hands on*" project, developed in 1992 in USA), aimed at revolutionizing science teaching in the primary school. It has deeply influenced the national programs for the primary school that the French Education Ministry proposed in 2002 and recently in 2008.

This project, as well as the "Hands on" one, is related to studies and researches which exhibit a common prospective change with respect to experimental science teaching: pupils and their learning processes are put in the centre of the teacher's action and pupils' competences are built on their direct experience with facts and phenomena of every day's life.

The *"La Main à la Pate"* project is already running since some years and represents a consolidated experience which directly interacts with the teacher's activity in the class and, as a consequence, can positively influence pupils' learning. The basic idea is related to an education community referred to all the partners (i.e., Universities and local organisations, families, students); all these features are present also in the Italian ISS project.

The French pedagogist Le Boterf (2001) states that for a pupil being competent implies a quality jump from the knowledge of a plain and executive "how to do" to a better and deeper "how to manage": this refinement lets the pupil getting as decisional as possible when facing new situations. Managing a situation means not simply doing well, but it implies to assume one's own responsibility to choose with consciousness. To learn how to choose is totally different from reproducing behaviours typical of other people: this upgrade implies that the pupil becomes the actor of his action, abandoning the role of plain executor.

The targets of both projects ("La Main à la Pate" and ISS) are totally overlapped: it is then vital to describe in more detail both of them, in order to evidence either common points and/or differences.

The Italian ISS project

The formative model of the ISS project is based on the following main points: (a) central position of the student (in this respect normally in the school the learning process leads to contents and not

vice-versa); (b) the identification/creation of contexts of sense, which could give to contents a significance sphere in order to support/strengthen the motivation for both pupils and teachers; (c) the "compatible" pedagogical meeting, which leads teachers to meet students where they are, i.e. in their own world: in order to follow students in their trips to emancipation it is first necessary to recognize their subjectivity and secondly to start from their own models, language and ideas about the "world"; (d) a total opening to all possible themes/subjects and the research of adequate languages to the different school levels, with reference to information-knowledge, connections-concepts, theories and models; (e) "listening" and research pedagogy, with reference to some peculiar aspects of the formative connection: the "active listening" implies both matching and reception of the reasons of the counterpart.

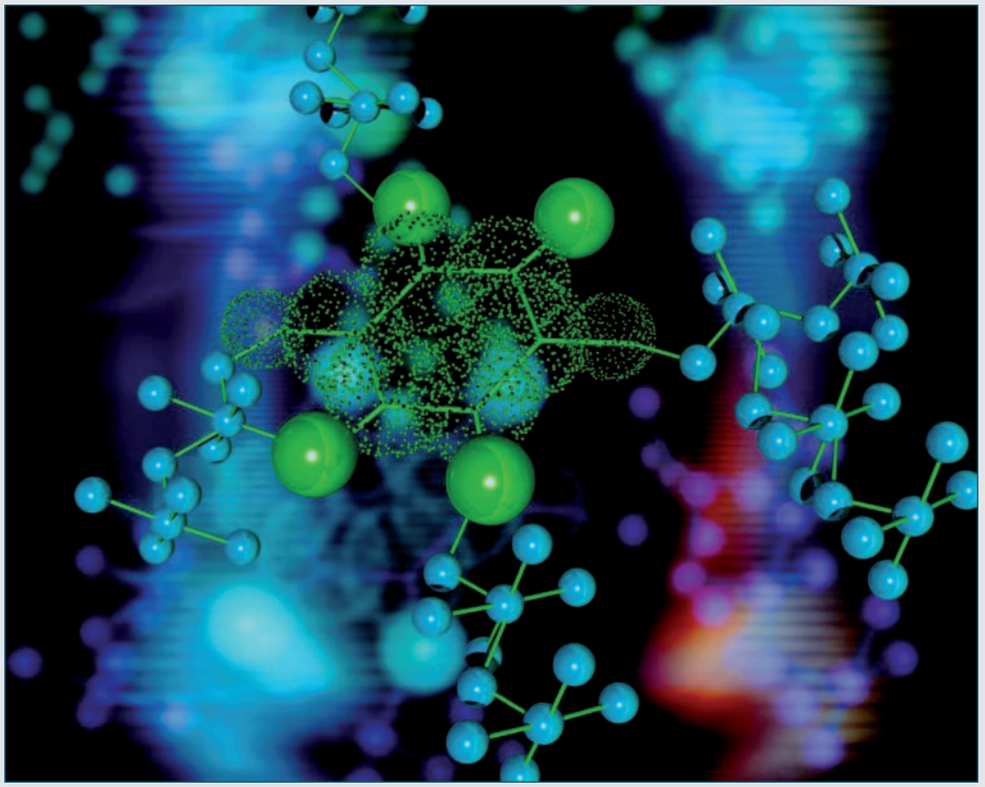
In order to shed some light on the above points, four main factors have been identified as *specific process indicators* (ISS indicators), because, as reported in the official documents of the ISS National Plan, they act as "network organisers" for the Formative ISS Plan. They are reported in the following:

1. *contexts of sense*, referred to concepts and contents of both every-day's life and teaching subjects;
2. *vertical approach*, referred to the possibility of developing a didactic action that can be re-proposed during the different school periods, in order to face different levels of subjects deepening;
3. *laboratorial didactic*
4. *competence goals.*

As for the *contexts of sense* in the teaching action, teachers should look first for the possible connections between contents and every day's life, but also with contents and "waiting"/"listening" dynamics in which students are posed. Teachers interested in experimental sciences and laboratorial didactic have then to train to look for contexts of sense, as they have to lead students to be more conscious about their own growing processes and to learn through the practical experience using an effective personal rielaboration of knowledge. Moreover, there will be a continuous reference to phenomena, both in real life situations and in emblematic case studies, either on spatial, causal or temporal scale, in order to learn how to "look at" phenomena and to employ the correct/adequate language.

As far as the *vertical approach* is concerned, this might not be reduced to a mere sequence of contents, but it should be a progressive development along different deepening levels, not only bonded to the different school levels of pupils, but mainly to either the different didactic settings (such as, for instance, socio-cultural composition of the class, gender difference, integration of foreign pupils and/or with different/special needs, etc.) or methodologies (with reference to those applicable in the various situations). All the above features carry out the evolution from the use of a unique curriculum, implying an exclusive linear development, towards the idea of a "curricular network", more coherent with the complexity which is at the basis of the teaching-learning process. It is worth noting that in the experimental Science teaching these processes will proceed step by step, starting from the spontaneous way of thinking up to more coherent and organised knowledge forms, in which pupils can actually verify efficiency and effectiveness. It is then vital to start to build one's own basic scientific knowledge in the early years of the primary school (or, possibly, in the pre-school period): it is well assessed that early, intensive, multi-systemic approaches offer impressive long-term results, most likely bringing the highest rates of return over the whole lifelong learning process.

As for the third indicator (*laboratorial didactic*), it is important to stress that most of the teachers consider the "laboratory" only as a place, where experiments can be easily carried out, rather than a context, in which (or by which) proposing a peculiar didactic action, useful to better the pupils' intellectual activity and groups' interac-



tion. In the lab, pupils can "meet" a specific phenomenon, developing both experience and critical sense about it (from hypotheses/expectations to their verification/confutation), in order to reach an inter-subjective share. Once the experiment is carried out, any conflict between what was expected and what has been observed should be negotiated: the teacher should then fuel the discussion among students and/or with them: he is a sort of a "mediator" or a "trainer". In any case, the goal is that students should gradually reach a view that is compatible with accepted science and/or formulate new questions.

Finally, the *competence goals* sum up all the above indicators. In fact, how could it be possible to use the laboratorial didactic without a direct connection to the central position of the student in this action? Moreover, how is it possible to deal with a phenomenon without taking into account pupils' foreknowledge or "naïve" models, if pupils must be considered real subjects in the learning process, rather than "objects" of didactics? Note that the "naïve" word is not aimed at diminishing the complexity that early models exhibit: in fact, it has been demonstrated that models elaborated by pupils in the primary school are rich of relations and connections (both intrinsic and extrinsic) typical of higher level cognitive structures. Naïve is just referred to the scholar level!

It is then evident that the ISS project proposes a significant change in experimental science didactic, as teachers should switch from a transmissive approach to a collaborative action (the so-called "research-action"): this implies the review of teachers' knowledge, skills and competences, in order to achieve the role of researchers involved in didactics, that we think it is a real science. This review process needs of systematic supports: the local units of ISS (the *presidi*) will act as reference units useful for professional development/update. As the "La Main à la Pate" project, ISS project represents a real "pedagogical adventure".

The French "La Main à la Pate" project

Georges Charpak, Nobel Prize for Physics in 1992, started to be highly interested in an experiment dealing with the didactic of sciences, carried out in a low level socio-economical situation in Chicago (USA). In this city, right to face the problems of deteriorated learning performances, violence and bullying, another Noble prize for Physics, Leon Lederman, launched in 1992 the "Hands on" project. Lederman (1992) was inspired by the basic principles of activism pedagogy (J. Dewey) and by the socio-constructivistic theories due to J. Piaget and L.S. Vygotskij: his target was to allow the scientific alphabetisation of pupils deprivated of a real high quality standard of teaching, in order to give them the same education opportunities, to lead them to understand phenomena and facts of the nature and to become active and "illuminated" citizens. In this perspective, the project proposed that at least one hour of teaching was to be devoted to Natural Sciences and Physics for all the seven years long of the primary school, (almost) always employing an experimental approach.

Pupils, in the 5-12 years age range, were posed in front of phenomena and/or problems, in order to propose hypotheses to be discussed among them, to build experimental evidences in order to both verify the above hypotheses and structure new knowledge, employing a positive approach made up of both manual and intellectual activities. Any action was then reported by pupils on their own "experiences workbooks", which also represented a good tool to improve/deepen their logical and language skills. During its course, the "Hands on" project revealed to be highly effective and allowed pupils living in socio-culturally disadvantaged contexts to fill the gap with both school and knowledge, to develop a good feeling in approaching with sciences, learning also to get into constructive relationship in discussions and group debates. As a consequence of its success, the project was then extended and adopted in several other states in USA.

Georges Charpak (2000) was enthusiast when got in contact with the "Hands-on" project: "When I was in a "ghetto" of Chicago, I saw children with sparkling glance discovering how the world "works" by using very simple, but well suited, objects: they discuss among them

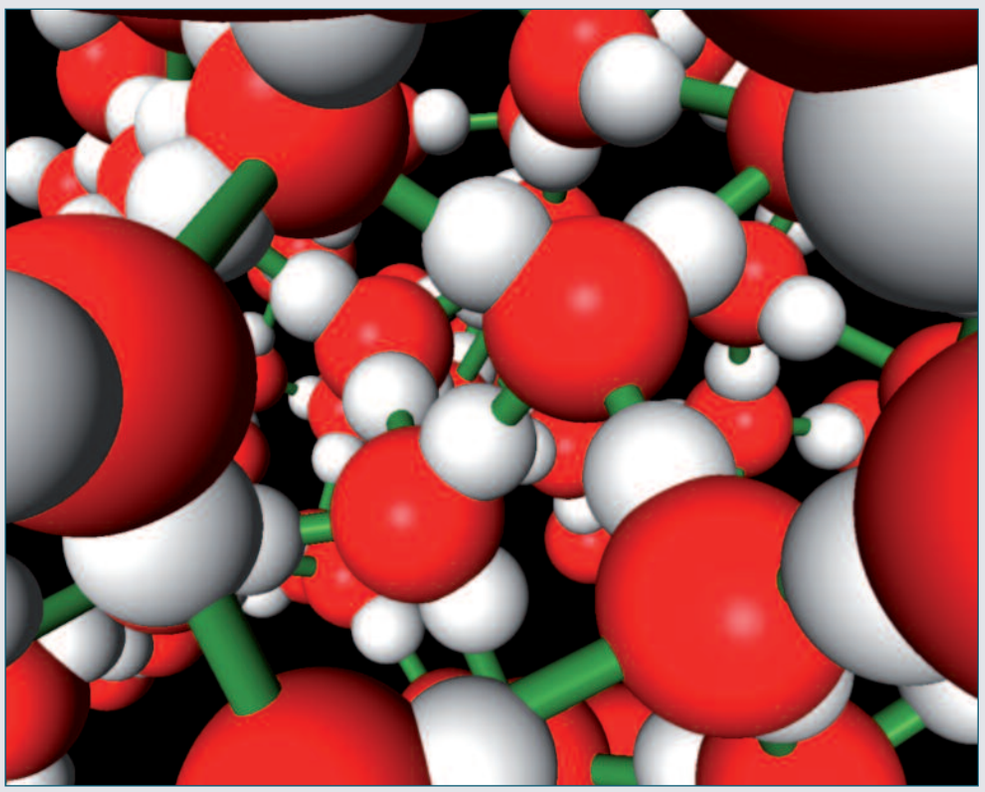
and with their teacher, trying to fix their observations with documents and drawings and to learn those concepts for which teachers planned all manipulations and experiments".

Charpak started his bureaucratic "fight" and in 1995 obtained a public financing from the French Education Ministry in order to visit that "ghetto" in Chicago, with a group of French experts, and let them becoming aware about the USA project. When the group went back to France, prepared a report about the pedagogical approach carried out in the USA evidencing the potential compatibility with the French situation. In France in early '90 there was a strong concern about those themes, in particular for two main reasons: (a) in 1991 the so-called IUFM (acronym for University Institutes for the Formation of Primary School Teachers) were created. These institutions had a basic role in the formation of these teachers, as they cooperated with the existing University system: this was a total organising novelty, which carried out significant pedagogical variations, as the starting formation of primary school teachers was from then on both disciplinary and "in the field"; (b) previous comparative international analyses emphasized the bad situation of the French Science Didactic: 13-years pupils achieved scarce results in Natural Sciences (i.e., Biology, Physics, Chemistry, etc.), whereas their mathematical performances were better if compared with those of same age foreign students.

The pedagogical report convinced the French Ministry authority about both the use of the Lederman's method and the pressing need to start: in September 1996 "La Main à la pate" project was launched. The project was devoted to all French pupils in some pre-school and primary schools: this is the main difference with the original "Hands-on" project, devoted to socially disadvantaged students. Many "actors" from the highest level of scientific formation were present on the French "La Main à la pate" scene: Science Academy, DIV (i.e., Interministry Delegation for the Urban Development), Ecole de Mines – Nantes (i.e. Mining High School), Ecole Polytechinque (i.e. Institute of Technology), Ecole Nationale des Sciences (i.e. Sciences National High School) and many more.

After the first year of activation (344 classes of 5 different French departments were involved), G. Charpak (2005) reported some preliminary considerations about his project: "… an experimental work carried out by pupils, both incited by a scientific question and dedicated to the formulation of explanatory hypotheses, with marks on pupils' "experiences workbooks" …". It is worth noting that mathematics was not involved in the project, as this subject (and its didactic) has traditionally a leading and recognised role: both Natural Sciences (such as Astronomy, Biology, Chemistry, Physics, Geology, Meteorology and so on) and Technology Didactics were taken into account, as their roles in the primary School still needed to be revised.

All the partners of the project assumed as starting point that pupils attending pre-school/primary school are *per se* "gourmand of sciences". As G. Charpak (2006) resumes: "In the 4-12 years age pupils live a real "Golden Age" referred to curiosity for the mysteries of nature, irrespective of their social milieu, or familiar/school difficulties or mastery of language as well". It is then very important to give pupils the opportunity to experiment with real life situations beginning from very simple materials, such as those present in every school context (i.e., balances, seeds, colors and dyes, balloons, metal pieces, levers, etc). Assuming this as starting point implies a total upset of the usual approach, admitting that: (a) learning difficulties, as well as scarce results, of French pupils in sciences are not (only) a matter of their own skills, rather than they depend on the kind of sciences didactic employed; (b) absence (or scarce quality) of scientific teaching are not to be due to the initial formation of teachers, rather than to their fear "to be unprepared and to be not able to". This is the reason why "La Main à la pate" project took care from the early stage of application to support activities for pupils with supporting actions for teachers.



In 1997-98 the project was extended to 2000 classes in primary schools (48 French Departments got involved), and other important supporting/integrating actions were proposed as well, among which:

1. a web site (www.inrp.fr/lamap), with the

twofold function with regard to both principles and methodologies typical of the project, in order to broadcast and network them, as well as the working "instruments" and the good practices until then realised;

2. the "La Main à la pate" prize, which from then on has been each year assigned to the ten best experiences, in order to give them visibility and public acknowledgment.

Nevertheless, some criticisms raised from those experts, who wrongly interpreted the emphasis of the project on objects' manipulations and "doing": they reduced the whole operation to a mere set of joyful proposals and activities, able only to amuse pupils. This critical aspect has also been raised for the Italian ISS project, but it is totally disagreed by most of people, as reported by Spitzer (2005) "It is a diffuse opinion that you can divide time into well separated periods, those devoted to learn and others devoted to pleasure … but your brain never stop learning".

It is interesting to inspect in some detail the formative model of the French project (published in 1998). It is based on ten main points: six of them concern the pedagogical bases (*la démarche pédagogique),* whereas the remaining four ones are referred to the partnership which always must be present to support the actors of the project itself.

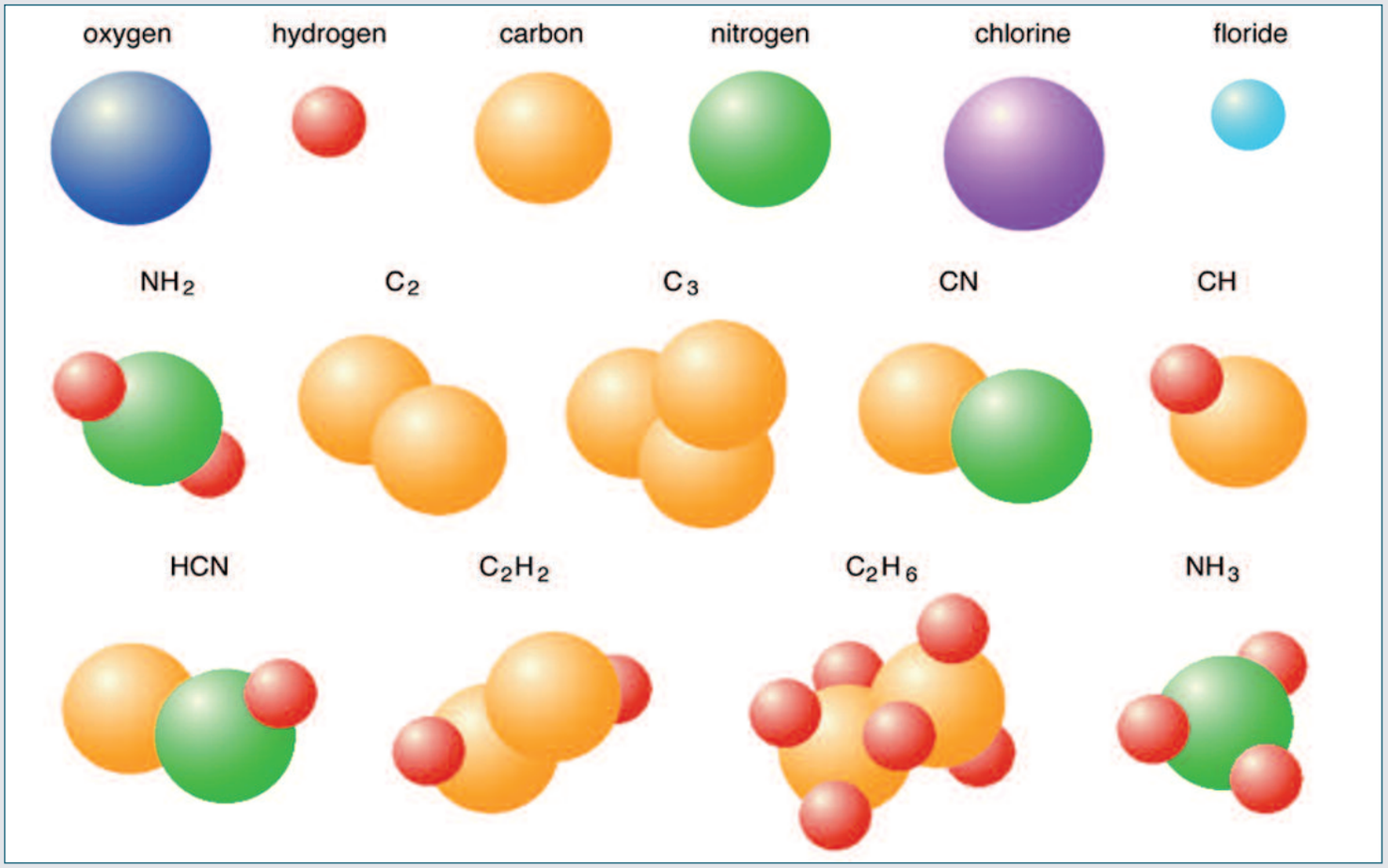
As for the pedagogical aspects, the following points are noticeable: (a) pupils first observe an objects and/or a phenomenon pertaining the world around them, then do some experience with/about it. It is worth noting that objects/phenomena are intended as "objects under investigation" (such as water, sky, mixtures, etc.): these may not be coincident with simple "material" objects which pupils can directly use/touch; (b) during their investigations pupils infer and argue, share and discuss their ideas and results, building up their knowledge: a plain manual activity is not enough to activate such a complex process. In a socio-constructivistic approach, pupils do not act as mere observers and manipulators, rather they must entirely be involved, throwing mind and body into action, in order to structure their own knowledge, opening a dialog with schoolfellows, scientific community and teacher. The latter plays the role of "mediator" between pupils and knowledge, acting as reference expert for the scientific concepts under study; (c) teachers organise experiments and activities in a sequential way, in order to make easy a progressive learning: this is why the whole "way" should be clear in teachers' mind, so that each activity can respect its continuity. In order to promote pupils' self-government there will be individual activities in turn with small group/joint discussions; (d) as for the time-table, it is important that at least 2 hrs weekly for a reasonable period will be devoted to a selected topic, in order to ensure the continuity among the various activities and pedagogical methods during the whole school year. In other words, it is absolutely necessary that pupils can quietly thought in order to structure meaningful knowledge; (e) each pupil must fill in a sort of log-book, his experience workbook ("*cahier d'expériences*"), using his own language, made up of two parts: the former in free form, in which the student reports spontaneously his own observations/considerations, the latter in a more organised way, in which he includes results and knowledge shared with schoolfellows; (f) one of the main targets is the progressive adoption of scientific concepts

and operative techniques from pupils: besides this, it is important that they strengthen both written and oral language. Primary school has then a fundamental role in "alphabetisation", as it is reported in the project web page: "There is a strict connection between scientific and language learning. This process can lead to a mutual motivation towards both learning, but sometimes pupils can be blocked because they cannot "translate" their ideas into correct words: it is then necessary that teachers thoroughly supervise, in order to avoid problems.

As for the partnership, it is important to recall that it has been founded to be a "training community", as reported in the following: (a) both families and districts are involved in the classes' projects; (b) the scientific partners (University, Institute of Technology, High Schools, etc) locally follow the projects in the classes with their competences in the different areas, supporting teachers with training activities, research-in-action, new ideas and so on. Once a week, since 1998, there is a meeting of these communities: teachers can then directly interact with scientists and discuss with them about the strategies for a good practice; (c) teachers belonging to the IUMF share their pedagogical and didactic experience with primary school teachers, both in their institutes and in the web. The "electronic" resources are very rich: a lot of didactic materials, activities, new insights are available on-line and there is always the possibility to interact with colleagues taking part to cooperative works, opening a dialog with trainers and scientists; (d) among the targets, the main one regards subtracting teachers from their own isolation, putting them in a "security" network in which they can find a daily support in teaching sciences. This action evidently implies, on one hand, that trainers (engineers, physicists, chemists, biologists, etc.) visit the classes adapting to needs and rhythms of pupils; on the other hand, teachers should share with them pedagogical cares, good practices and new ideas.

Since 1999 the project directly involves ~2% of the French primary schools: some Ministry reports, such as the Sarmant report in 1998 and the Loarer report in 2002, put into evidence the highly positive effects, obtained not only in the peculiar scientific field, but also in language and the general leranig process of pupils. In June 2000, the French authorities decided to launch the PRESTE plan (2000): this is a three-years project devoted to a deep renewal of both Sciences and Technology teaching in the primary school, prepared with specific reference to the European indication deriving from the Lisbon declaration published in the same period. The PRESTE plan is aimed at the gradual diffusion of the "La Main à la Pate" methodology in all French primary schools in continuity with the existing local partnerships. The Science Academy keeps on carry on its supporting action towards the scientific community. In 2001 a network of some twelve "La Main à la Pate" "pilot centres" was born: these centres are highly dynamic in experimenting new "good practices" and have the aim of diffusing them all over France.

"La Main à la Pate" methodology is now-a-day all over the world successfully recognised as one of the best examples of innovation in sciences teaching: since 2004 more than twenty nations, among which Belgium, Afghanistan, Brazil, Cambodia, Egypt, Morocco, etc., are involved in collaborative projects, with active partnerships and creation of an international web site.



"La Main à la Pate" project has been widely recognised in France and has deeply influenced the national programs for the primary school that the French Education Ministry proposed in 2002 and recently in 2008.

Conclusions

All what we reported so far, allows us now to summarise the contexts of sense of both French and Italian pedagogical projects. The projects exhibit a common area, and this aspect must be further stressed, as between them there has been almost no significant contacts: both projects raised because of autonomous and distinct needs. This common area recognises the absolute central position of the student in his learning process; moreover, the teacher possesses the fundamental role of "leader" with respect to his pupils in order to bring about their emancipation and become autonomous, along a way not necessarily coincident with that of the teacher.

The central role of the student pertains also freedom and citizenship: teachers can "open the door" of the scientific knowledge, but only students can decide to enter. It is then important to underline that, without putting too emphasis onto the pedagogical aspects, both projects pose the highest attention towards the *competences goals* (i.e., conscious behaviour of pupils) rather than concentrating onto the *learning targets* (i.e., contents, concepts, abilities). The school system based on this implant, either in France or in Italy, deeply differs from that of the recent past: the latter system limited its action in verifying that the learning process was corresponding to the teaching action, as if the emancipation of students would be a mere teaching question rather than being a total assumption of those decisional responsibilities typical of an active citizen. These responsibilities well correlate with competence, i.e. with the capacity in case of need (problems to be faced, phenomena to be explained, interpreted or governed) of recalling all the necessary resources. This habit requires a typical kind of learning, that F. Varela (1992) defines "embodied", because it must involve both the mind and the whole body even its biological roots: the learning process, which both Italian and French projects inspire to, recalls the metaphor of the nutrition of our bodies. Organisms need food to live, as well as the student-citizen needs culture and knowledge to actively participate to social life. Organisms "elaborate" and transform food, in order to be assimilated, i.e. to become totally similar to what we are, so that no distinction could be evidenced from blood or corpse we are made of. Similarly for learning: it transforms notions and concepts in knowledge which pupils "eat", but only in front of a rielaboration process they became really assimilated. Learning and eating share a preliminary need: hunger, i.e. the stimulus to assume vital energy. This is not typical of a single human being as stated by R. A. Alves (1990), but

this behaviour possesses an important social dimension: in fact, pupils call the other pupils "schoolfellows", as they share the same bread eating it in communion.

Finally, we can state that both projects, "La Main à la Pate" and ISS, could pick up and elaborate the novelties brought about in science teaching by the socio-constructivistc approach, in good agreement and coherently with the indications coming from either European and/or international contexts, leading to the building up of an organic formative context which located well above the sum of the single built parts.

The French context started earlier with respect to the Italian one, which in any case is carrying on highly significant changes, thanks to an action involving all the territory in the ISS network. Unfortunately good actions and clever initiatives are too quick to be accepted even in the cultural context they were born in: actually in Italy the problem derives from the heavy reduction of personnel employed in the school, as a consequence of both general economical crisis and scarce attitude of Ministry authorities towards scientific education. If on the pedagogical ground, internationally speaking, Italy has a good behaviour, on the other hand, the ISS project is now in concrete difficulties, because of the very recent restrictive government decisions about school: maybe now-a-day we are a bit more alone than in the recent past. We hope for the future of our students this impasse could be overcome!

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Bibliografia

[1] R.A. Alves, The Poet, the Warrior, the Prophet, London, SCM Press, 1990.

[2] G. Charpak, in J. Dercourt, J.P. De Gaudemar, J.P. Sarmant, F. Gros, De l'opération La main à la Pate au Plan de rénovation de l'enseignement des sciences et de la technologie à l'école, 2000. La Main à la Pate web site [online] http://lamap.inrp.fr

[3] G. Charpak, in G. Charpak, P. Lena, Y. Quere, L'Enfant et la Science. L'aventure de La Main à la Pate, Paris, Odile Jacob, 2005.

[4] G. Charpak, in G. Charpak, P. Lena, Y. Quere, La Main à la Pate, dix ans après. Cahiers Pédegogiques, n. 443, Paris, CRAP, 2006.

[5] DD-SCI, AIF, ANISN: Divisione Didattica della Società Chimica Italiana, Associazione Insegnanti di Fisica, Associazione di Insegnanti di Scienze Naturali.

[6] ISS National Plan, in E. Balzano, A. Fichera, I. Gatti, S. Sutera, Piano ISS, 1° seminario Nazionale, Milano e Napoli, documenti di lavoro, Roma, Atti 1 e 2, M.P.I. Dipartimento per l'Istruzione, Edizioni Museo Nazionale della Scienza e Tecnologia, 2006.

[7] G. Le Boterf, Construire les compétences individuelles et collectives,. Paris, Editions d'Organisation, 2001.

[8] L. Lederman (1992), in A. Zapata, Histoire d'un succès, Cahiers Pédegogiques, n. 443, Paris, CRAP, 2006.

[9] OCSE-PISA survey [online] www.oecd.org/document/2/0,3343, en_32252351_32236191_39718850_1_1_1_1,00.html

[10] T. Pera, L'aggiornamento partecipato e la didattica laboratoriale, Piano Nazionale Insegnare Scienze Sperimentali, le motivazioni ed i valori", *La Chimica nella Scuola,* **2**, 2007.

[11] PRESTE project, in French Official BOEN Bulletin, n. 23 June 15th 2000.

[12] F. Varela, Un know how per l'etica, Bari-Roma, Laterza, 1992.

RIASSUNTO

Insegnare scienza nella scuola primaria. Un confronto tra Francia e Italia nel 21° secolo

"La Main à la Pate" (ovvero, La Mano in Pasta) è un importante progetto di sperimentazione avviato in Francia nel 1996 con l'intento di rivoluzionare l'insegnamento delle scienze nella Scuola Primaria. Esso ha profondamente influenzato i programmi nazionali per la scuola primaria proposti dal Ministero Francese dell'Educazione nel 2002 e recentemente nel 2008. Il progetto è una vera e propria "avventura pedagogica", che ha come principi la centralità dell'allievo, la sperimentazione diretta, l'intimo legame fra scienza a linguaggio, l'attenzione particolare allo sviluppo dell'immaginazione e della creatività dell'allievo insieme al ragionamento logico e al rigore mentale. Questi stessi principi sono alla base del Piano Nazionale ISS - Insegnare Scienze Sperimentali: il Piano è stato proposto dal Ministero dell'Istruzione, dell'Università e della Ricerca (MIUR) nel 2005, in collaborazione con alcune associazioni scientifiche disciplinari: la Divisione Didattica della Società Chimica Italiana, DD-SCI, l'Associazione per l'insegnamento della Fisica, AIF, e l'Associazione Nazionale Insegnanti di Scienze Naturali, ANISN, e con due Musei Scientifici (il Museo Nazionale della Scienza e della Tecnologia "Leonardo da Vinci" di Milano e la Città della Scienza di Napoli). Attualmente sia nelle Indicazioni per il Curricolo per la scuola dell'infanzia e per il primo ciclo d'istruzione (MPI, settembre 2007), sia nella pratica didattica di molti docenti possiamo ritrovare alcuni importanti richiami alla "filosofia" sottesa dal progetto ISS.

L'obiettivo finale è il conseguimento da parte degli allievi di "traguardi di competenza" distribuiti gradualmente lungo i diversi livelli scolastici, mediante una didattica caratterizzata dai seguenti indicatori: (i) laboratorietà, (ii) contesti di senso, (iii) verticalità, (iv) trasversalità.