Setting standards in science education: a comparison between a centralized and a de-centralized school system - France and Switzerland

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ABSTRACT

In order to improve the quality of instruction and educational outcomes, many European countries develop and define performance standards in which students should achieve specific standards in subjects such as their first language, mathematics or science. Which conditions, therefore, are important for the development and setting of standards? In order to attain a broad spectrum of answers, two countries with two completely different school systems are analysed: France as a paradigmatic example of a highly centralized school system and secondly, Switzerland as a typical country with a federal de-centralized system. France is on its way to introducing the so called 'common base' (socle commun), a framework for the guidance and curriculum for the future schooling, whilst Switzerland is in the process of implementing the 'Harmonization of compulsory school' (HarmoS) project. Firstly, focusing on science education, this article examines both countries separately exploring the individual country's processes of setting standards in science education including its objectives and contents, the persons and stakeholders involved, the different steps and phases undertaken. Next, the similarities and differences between the two countries are identified. Finally, on the basis of these comparisons, conclusions and implications can be drawn in setting standards in science education.

KEYWORDS (4-5): steering a school system; compulsory school; setting standards; competence model; science curriculum

In the last ten years, several countries, in particular in Europe, have either introduced standards or are on the way to doing so. Most of the standards are intended for all school subjects including science, i.e. biology, chemistry, and physics. There are a variety of reasons for setting standards. One reason may pertain to particular international evaluations, such as the Trends in Mathematics and Science Study (TIMSS) or the Programme for International Student Assessment (PISA, see OECD 2004, 2007). The results of these studies have been sobering for many countries and led to different political measures, in particular to the setting of standards. As PISA has shown, countries that have a tradition of setting and implementing standards have better outcomes than countries that do not have this tradition. Other reasons for setting standards - and simultaneously for curriculum development - may be new insights and content (in biology, chemistry or physics), new or rediscovered cross curricula skills (like 'to communicate', 'to judge' or 'to work self-reliantly'), gender issues, the lack of scientists and engineers or a stronger focus on interdisciplinary approaches, as described by Witz & Lee (2009).

Setting standards is not a completely new means in developing a school system or the instruction of a specific subject like science. Some countries with a centralized school system and nationwide tests have had standards for many decades. Most of the time, these standards are linked, at least indirectly, to examinations. In Europe, this is the case, for example, in France with its Brevet and Baccalaureate examinations (see next chapters) and in England with its General Certificate of Secondary Education (GCSE; for 16-year-olds) and General Certificate of Education A-level (GCE; for 18-years-old). In England, learning outcomes are specified by a syllabus, which indicates both the topics and a general indication of the balance in the examination between knowledge, i.e. mainly recall, and understanding (Millar et al. 2012). Critics point out that pupils in England are subjected to more national external exams as the principal means of assessing their knowledge and skills than in any other country in the world (Richards 2000) and that an industry has developed fort the primary purpose of testing and classifying children (Alderson 2003). During the 1990s, also other Anglo-Saxon countries made standards explicit which included those by the National Research Council NRS (1996) in the USA, and those by the Council of Ministers of Education (CMEC 1997) in Canada. The titles of the two reports are unambiguous: 'National Science Education Standards' in the US and 'Common Framework of Science Outcomes' in Canada. The majority of European countries have not maintained educations standards. Only in response to the PISA-results some of them introduced standards, among them Austria (BMUK 2011), Germany (KMK 2004a-c), Luxembourg (Ministère de l'Education nationale 2009), Switzerland (EDK 2011; see next chapters) and Turkey (Ayas 2012). Some of these countries are on the way to implement – parallel to the standards – new nationwide or in federal systems statewide examinations. Other European countries abstain from setting standards. For example in Denmark the science curriculum describes core knowledge and skills for pupils to learn and also guidelines for teachers to develop their teaching; but Denmark does not know nationwide standard-based assessements (Dolin 2007). The same is true for Finland, which has content-oriented curricula and a long tradition of decentralized assessments and school development (Lavonen 2007).

These examples from different European countries might show the broad spectrum of setting standards and assessing students' knowledge and skills. Waddington et al. (2007) and Bernholt et al. (2012) have pointed out that setting standards is mutually an ambitious project and venture, which depends on a country's tradition and values, the kind of school system in place (centralized or de-centralized), the school structures, and the use or non-use of nationwide-tests. Titling their books 'Making it comparable: standards in science education' and 'Making it tangible: Learning

outcomes in science education' the editors wanted to emphasise the advantage of standards by allowing comparisons to be made between students, classes, schools or countries providing the means from which outcomes and equal opportunities could mutually be improved. While indications show that setting standards has some advantages, what is understood by the term 'standards' is rather different depending on the country in which it is employed. That is, 'standards' could correspond to either precise teaching content or to general aims of education or to the evaluation of standards which also differ from one country to the next.

While Waddington et al. (2007) and Bernholt et al. (2012) provide a general overview of different objectives, approaches and implementation of standards in various countries, in this paper we focus on European countries which can be qualified as paradigmatic for a specific group of European countries. On the one hand, there is France with a highly centralized school system and on the other hand, Switzerland with a completely de-centralized federal system. More than six years ago, both countries began a long process with the goal of setting and implementing standards, which also took into account science education. With this in mind, the objectives of our study are:

- to describe, for both countries separately, the process of setting standards namely, its objectives and contents, the persons and stakeholders involved and its different steps and phases,
- to compare the Swiss and French process by identifying the similarities and differences,
- to gain insights about the various conditions important when setting standards.

The article is divided into four chapters: in the first two chapters, we describe the Swiss project, 'The harmonization of compulsory school (Harmonisierung der obligatorischen Schule, HarmoS), and the French project, the 'common base' (le socle commun). In both chapters we employ the same categories and structure:

1. Educational system
2. Reasons for setting standards
3. Main steps
4. Subjects
5. Participants
6. Cooperation between participants
7. Competence model
8. Skills and knowledge
9. Levels
10. Validation of the model
11. Implementation
12. Research and development projects.

Categories 1-6 belong to a more general frame, 7-12 to standards in science. - In chapter (3) the similarities and the differences between the Swiss and French projects are analysed. Lastly, chapter (4) ends by providing conclusions and implications for setting standards in science education.

Switzerland: 'The Harmonization of Compulsory School (HarmoS)'

1. Educational system: The Swiss education system is federalistic whereby the responsibility of state education is handed over to the cantons. Since the first constitution of 1848, the principle of subsidiary has marked the spirit and the comprehension of Swiss federalism. The question whether or not the Confederation should define minimal requirements to be imposed on elementary schools in the whole country had already been raised as far back as 1873. How-

ever, because of denominational reasons a public vote in 1882 buried for a long time such centralizing ideas. Nonetheless, in 1897 the Swiss conference of all the cantonal ministers of education (EDK) was founded and nowadays brings together 26 'cantonal ministers of education'. Throughout the 20th century, questions concerning the teaching programmes were regularly discussed and coordinated by the EDK, but cantonal sovereignty concerning education was never reduced, despite two parliamentary attempts at the federal level.
Re-interrogated at the beginning of the new century, a clear separation of competences for educational policy was, for the first time in Swiss history, largely accepted (by 86% of the citizens and by all the 26 cantons) on May 21, 2006. As a result, new constitutional articles confirm education to be the responsibility of the cantons, but oblige the Confederation and the cantons to collaborate, particularly in favour of the quality and the permeability of the education system. Permeability implies that mobility inside the country and between degrees of school is supported by various measurements (coordination, recognition, bridging systems, etc). The new article 62 al. 4 of the Swiss constitution specifies that the cantons have to harmonize compulsory schooling, i.e. to harmonize, above all, the duration and the objectives of teaching as well as the transition from one school level to the next, or else the Confederation will force those cantons, which are not willing to harmonize, to do so.
In Switzerland, one distinguishes between harmonization and standardization. Harmonization means 'bringing closer' - but not to unify completely - the structures and contents of teaching. Complete centralization and conformity in Switzerland would be incompatible with Swiss traditions and mentality where many decision makers collaborate on a small territory. That is, problems are resolved through a consensual instrument, e.g. regulations or a concordat which has to be negotiated at length. As a result, consensus leads to harmonization and not to enforced conformity.

2. Reasons for setting standards: Switzerland constitutes a particular linguistic and cultural entity with its four national languages, three linguistic areas and an average of more than 23% of migrants, strongly present in the urban areas. There are still some important structural and curricular differences of compulsory school within the cantons.
In 2002, at the end of a long process of maturation, the EDK decided to reinforce the harmonization of compulsory school (HarmoS) by launching the preparation of a legal agreement between the cantons (a legal settlement) and instruments of coordination legitimated by it. At a time when the adoption of new constitutional articles appeared unlikely, the decision was taken to harmonize both the contents of teaching and school structures, as well as to create standards of formation. This resulted in, on the one hand, an increase in transparency and a common understanding of requirements, while, on the other, to control competences which compulsory school has to transmit in some key-disciplines and to assess the school system in relation to national scales. The publication of the first PISA results constituted another factor of influence. Subsequently, it is necessary to mention that in Switzerland a national certificate at the end of compulsory school does not exist seeing as the political objective is rather to have at least 95% of the students (today a little less than 90%) obtain a certificate of the post-compulsory degree (ISCED 3). As a result, the standards have to constitute a binding common framework of reference without being at all a standardised examination or a selective instrument. The standards seem to form the consensual instrument mentioned above in paragraph 1. In a country with a strong German-speaking majority, the political leaders and their education advisors will look to German, Austrian and even Dutch and Scandinavian contexts for direction than the French-speaking or Anglo-Saxon models. The latter are not taken into consideration due to their strong centralization and standardized evaluation processes and nationwide tests. Over time, careful reflection of the processes, led

within the country between the main three linguistic areas, will result in a Swiss national standards procedure. Within this framework, two goals will always be combined: the harmonization of both the curricula and quality in a competing system, two ambitious objectives for which the introduction of standards will certainly not be able to fulfil.

3. Main steps: Following this mandate entrusted to the EDK, the first task consisted of defining the type of standards most relevant for the Swiss system. In Germany, the KMK (equivalent to the EDK), very quickly adopted 'regular' standards. An analysis led under the direction of the German Institute for International Educational Research (DIPF) pled for performance standards based on models of competences. This supposed a theoretical and didactical approach, a solid empirical base and, eventually, a positioning of the standards on a progressive scale, with a clear preference of minimal standards (Mindeststandards); the expertise of Klieme et al. (2004) made it possible to mutually define options and working methods adapted to the Swiss situation.
Set up as a scientific project, it proceeded in four stages. During the first stage (2005-2006), a competence model for each discipline was developed in which knowledge and skills were defined. Standards were described as so called 'can-dos', i.e. 'the student can do …' and refer to four or five levels of progression. Then, specific problems, i.e. test items, were defined and adapted for the various levels and translated in the three national languages. In spring 2007, a vast empirical validation of the model was undertaken in classes with a representative national sample of more than 8,000 pupils at the end of primary and secondary school (grades 6 and 9). At the end of grade 2 the sample consisted of only about 600 pupils (for more details see below chapter 1, paragraph 9). The final stage (2007-2008), comprised in adjusting the model of competences starting from the empirical results or, in the absence of these for certain skills, on the basis of theoretical and didactical arguments to finally determine a relatively limited number of basic standards inside the model, in conformity with the editorial frame given by the EDK. Essentially, the standards had to be reached by more than two-thirds of the pupils, the average of satisfactory resolution of the tests generally ranging between 80 to 90%. Until 2010, the presentation of the standards was given in consultation to all the cantons and of all the institutions concerned.

4. Subjects: For the first generation of Swiss standards, the decision was taken to concentrate, at least to start with, on four disciplines and three milestones of schooling. The standards relate to basic competences that must be acquired at the end of the 2nd year (8 year old pupils), the 6th (end of primary school, 12 years old) and of the 9th school year (end of secondary I, 15 years old). The four treated disciplines are the language of schooling, mathematics, foreign languages and natural sciences. Within the natural sciences, the intention is to reorganize and prioritise the discipline treated very heterogeneously and to integrate techniques and technologies as well as education in health and sustainable development.

5. Participants: The direction of the project at the EDK launched an invitation to tender at the beginning of summer 2004 and four scientific consortia were set up within the first quarter of 2005. Taking the lead, an institute of teacher education or a University was obliged to build up a team with partners of the two other linguistic regions in Switzerland. The consortia unified between ten and twenty experts, amongst those also a network of interlocutors who, together, made up a team of more than one hundred people. Acting on a mandatory basis and under contract of the EDK, the scientific consortia brought in 50 to 70% of the financing. In parallel, a group of psychometricians were engaged to conceive the empirical operation of validation and to assist the consortia.

6. Cooperation between participants: There are scientific reports published by the EDK, which remain under the responsibility of the consortia who worked them out. Moreover, they are authorized to use the collected data, to carry out publications and to continue specific research. The final standards concern the political decision, i.e. of the conference of the cantonal ministers. Subject to corrections or complements after consultation, the standards of education will be adopted by the EDK by June 2011, becoming official and binding for all cantons which, in the meantime, will have ratified the legal settlement of HarmoS (for more details, see http://www.edk.ch/dyn/11737.php).

7. Competence model: The Swiss consortium HarmoS Science has developed a three dimensional competence model (Konsortium 2008, Labudde 2007, 2008, Labudde et al., 2012). It includes three axes: skills, domains and levels. Figure 1 shows the model in its final version as it has been proposed to the EDK. At this point, it should be mentioned that there have been previous versions of this model that have been validated and changed in several steps (see below point 10).

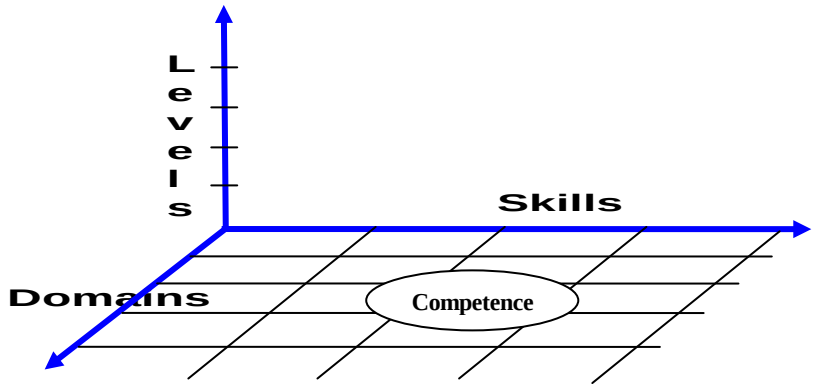

Figure 1: The three-dimensional competence model for science: A competence at the intersection

The term ‘competence’ is influenced by the definition of Weinert (2001): '[Competences are] cognitive abilities and skills possessed by or able to be learned by individuals that enable them to solve particular problems, as well as the motivational, volitional and social readiness and capacity to utilise the solutions successfully and responsibly in variable situations'. In the proposed model in figure 1, it is only at the intersection of a skill and a domain where a competence can be achieved. That is, both axes are required, one from the skills axis and one from the domains. This definition does not correspond to other models, in which the terms ‘competence’ and ‘skills’ are used synonymously.

8. Skills and knowledge [1]: The first axis comprises eight skills [2]: 1) to show interest and to be curious, 2) to ask questions and investigate, 3) to exploit information sources, 4) to organize, structure and model, 5) to assess and judge, 6) to develop and realize, 7) to communicate and exchange views, 8) to work self-reliantly and reflect.
Each of the skills is described in detail and consists of several sub-skills. For example, the skill 'to ask questions and to investigate' includes: 1) to examine consciously, 2) to raise questions, problems, and hypotheses, 3) to choose and use suitable tools, instruments, and materials, 4) to perform investigations and experiments, 5) to reflect on results and methods. The axis of the skills

has been declared the primary axis for two reasons, firstly, the consortium wanted to concentrate on this axis in order to avoid a mere catalogue of concepts and secondly, the levels should be defined on the basis of the skills and not on the domains.
The second axis includes 1) planet earth, 2) motion, force, energy, 3) perception and regulation, 4) structures and changes of matter, 5) organisms, 6) ecosystems, 7) human body, health and well-being, 8) perspectives in: nature, society and technology. The domains as a whole resemble the concept of STSE (Science, Technology, Society and Environment). In the large majority of Swiss cantons, science is taught as one interdisciplinary subject called 'science', 'nature and technology' or similar. This holds for pre-school up to the end of compulsory school, i.e. grade 9; it is only at upper secondary school that biology, chemistry, and physics are taught as three separate subjects. Each of the domains is characterised by the title (see above), about four sub-domains, a few basic concepts and keywords, and some paradigmatic examples. For example, the domain 'human body, health, well-being' comprises four sub-domains: 1) human biology, 2) health, 3) risk and risk factors, 4) health literacy. Typical concepts include the cardiovascular system, the development of sexuality, mental health and disease.
Contrast to the list of skills that claim to be final, the list of domains is not: a competence model should not be the same as a core-curriculum or as a curriculum that has to include a final list of contents.

9. Levels: The third axis comprises four levels (I to IV) for each of the grades 2, 6, and 9. Some of the levels overlap, e.g. the highest level of grade 2, i.e. 2/IV, is already the lowest level of grade 6, i.e. 6/I (see figure 2). The levels are progressive in the sense that a student can develop his or her competence from the lowest level of grade 2 to the highest level of grade 9. This progression is assumed to be soft and not rigorous, taking into account that students do not progress at the same pace; each student makes progress at his or her own pace (Labudde 2008).
Each of the skills and their sub-skills are meticulously described. In the plane given by the first and third axis hundreds of 'can-do-descriptions' have been formulated. For example, for the sub-skill 'to perform investigations and experiments' the lowest level in grade 2 is proposed in the following way: 'The students can perform easy observations and investigations to answer simple given questions, with material that is given.' Whereas for the highest level in grade 9 it is claimed: 'The students can plan and perform observations and investigations to answer given questions and hypotheses. They can - to some extent systematically - collect and interpret data (examining specific variables, confirming or rejecting hypotheses). Doing so, they can conclusively give their view to the questions and hypotheses" (Konsortium 2008).

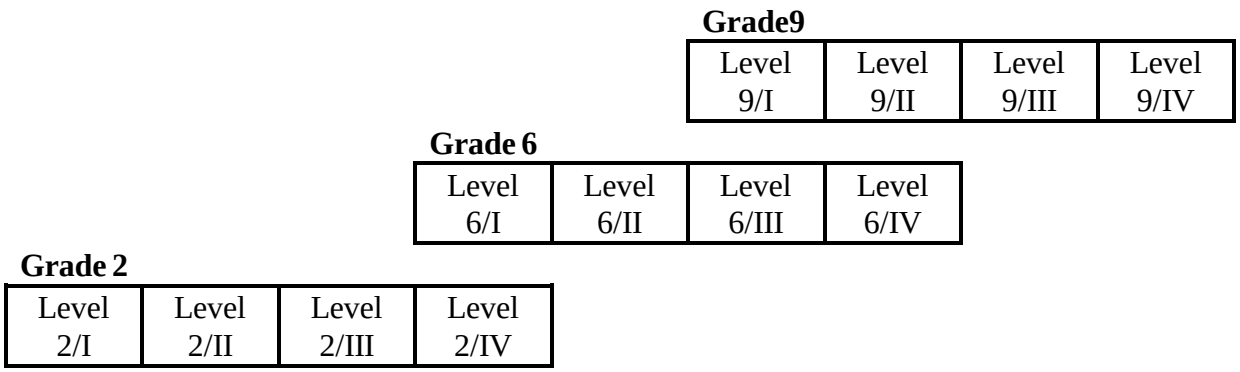

Figure 2: Four levels, I-IV, for each of the grades 2, 6, and 9 with an overlapping between grades 2 and 6, and grades 6 and 9, respectively.

10. Validation of the model: As mentioned above the consortium HarmoS Science had to propose basic standards on the basis of the model. In order to attain this objective, and to be able to propose standards that are realistic, the consortium had to validate the model and future standards. For the validation, the consortium chose a qualitative and a quantitative approach. It is the combination of both that is new in setting standards.
The qualitative approach was to some extent a member check. It included the company and the advice by an expert group (school administrators, policy makers, researchers, and teachers) and by more than 30 ordinary teachers. They gave feedback on the model and the tests in addition to piloting the problems given in the tests. What is more, the model and paradigmatic examples of test problems have been presented and discussed in almost a hundred talks, conferences and workshops with several thousands of teachers and other experts.
As figure 3 summarizes, the quantitative approach comprised several complex tests: paper&pencil (p&p) and performance tests. The p&p problems were PISA like, i.e. at the beginning a stem, followed by 4 to 6 items. The performance tests consisted of short lab and/or hands-on-activities (see figure 2). The sample included: i) grade 9: paper&pencil test 3888 students, performance test N=805; ii) grade 6: p&p test 4124 students, performance test N=663; iii) Grade 2: N=593 students answered a test that consisted of both p&p problems and hands-on-activities.
In total, more than 100 paper&pencil-problems (with about 500 items) and 26 hands-on- and lab activities were applied. Each of the students answered between 4 and 6 p&p-problems and worked on 2 activities. A rotation plan guaranteed that each problem and activity was answered by at least 150 students; for each of the tests a Rasch analysis was carried out. The numerous empirical results allowed to determine the status quo of students' competences and to propose both basic standards and paradigmatic examples of problems.

grade	**type of test**	**date**	**sample students**	**sample classes**
9	paper&pencil test	spring 2007	3'888	273
	performance test	spring 2008	805	44
6	paper&pencil test	spring 2007	4'124	255
	performance test	spring 2008	663	30
2	combination of paper&pencil and performance test	summer 2007	593	30

of a specific skill and domain.
Figure 3: Overview over the tests that have been used to validate a first version of the competence model.

11. Implementation: The member check and the proposition of standards, which includes paradigmatic examples and several opportunities-to-learn (Konsortium 2008: 179-212), are the first step of implementation. Others will follow including: a broad hearing procedure of the proposed standards (2009/10); the development of new curricula for each of the three linguistic regions of Switzerland, curricula that will be framed by the proposed standards (curricula to be finished by 2014); new teacher programmes and new programmes for professional teacher development (from 2012); establishment of an educational monitoring system and finally, establishment of a further support system for schools and teachers (from 2014 or later, see EDK 2004).

12. Research and development projects: The development, validation, and proposition of a competence model and of standards in science education was the first such research project. Others will follow: the description, promotion, and measurement of specific skills that are not elaborated sufficiently like the skill 'to communicate and exchange points of view'; the analysis and comparison of different competence models (Waddington et al. 2007); broad and sustainable programmes for professional teacher development (see for example the programme SWISE, Swiss Science Education, www.swise.ch). In Germany, Austria, and Switzerland research and development projects like those mentioned above are a big issue and the topic of numerous publications and conferences (Labudde et al. 2009).

France: 'Socle commun'

The French system has been a centralized system for more than two centuries. This centralization concerns material organization of schools, status of teachers, and teaching objectives, initially in terms of knowledge and since 2005, as in many other countries, in terms of competences. In this part, we draw a general history of the origin and evolution of national standards in France.

1. Educational system: In France, at the end of the 18th century the government decided to become responsible for compulsory education. The idea was to build a centralized network for compulsory education based on a centralized national administration, enabling the instruction of all social classes within the school of the Republic, and to help the teachers to choose appropriate teaching methods. This centralized system reinforces an image of a completely unified nation, with no local cultural differences. Compulsory education has been standardized on the basis of academic knowledge. Thus, the description of knowledge to be taught refers to the system of science and to the knowledge which the academic communities recognize as genuine scientific knowledge: not too far from the scholarly knowledge.
The force of such a system has certain disadvantages. The centralization strengthens the social cohesion but creates additional complications for any reform scheduled. Indeed, each reform has to be explained, through adapted support, to each of the school partners, i.e. the teachers and the students, but also the administrative management teams, and the parents that are stakeholders, as co-educators, of the French schools. Many reforms have been rejected or incorrectly carried out because they were not understood well or felt unnecessary by school partners. Following two centuries of knowledge centered curriculum, French stakeholders are not prepared to integrate a competence based model. Moreover, in this highly centralized system, the passive attitude of teachers towards the competence standards can be understood as a reflection of the lack of individual support offered by the ministry. In this system, all decisions made by the ministry have to be enforced by the school's decision-makers, with no official potential to adapt changes to local specifications or cultural differences, even though local experiments might be carried out if registered by local education offices.

2. Reasons for setting standards: If reasons for setting knowledge standards can be found at the very beginning of compulsory school during the 18th century, the main reasons for setting new standards in the last decade, including competences, have been clarified by the High committee for Education (Haut conseil éducation, HCE, mainly formed of university professors and general inspectors of the ministry of education), before the official publication of the law. The recommendations published first by the HCE and then in the statutory order (Journal

Officiel 2005) are called 'socle commun'. The reasons put in the foreground come from general observations of education failures, and match the European objectives adopted in the Lisbon's strategy (European parliament 2000):

- too many students leave school without any qualifications,
- schools still do not promote real equal opportunities,
- schools should better prepare students to live together in a responsible way.

The HCE (the High Council of Education) proposes responding to these problems by reorganizing teaching contents on the basis of a set of standards, corresponding to knowledge and skills; no-one should be ignored, on pain of being marginalized or disabled. Once the level of this socle is obtained, everyone can continue to learn, all throughout their life, and adapt to societal developments. The French nation has committed itself to enabling everyone to master this socle commun at the end of compulsory school. These objectives intend to enable all French students, as future citizens, to understand and participate in the economic development of the nation and of Europe. Traditionally, those economical issues are not taken into account in French compulsory schools but in vocational schools. Thus, it appears that both the European recommendation and the French system's ambitions are closely combined in the arguments officially stated for setting standards.

3. Main steps: Beyond the centralized administration of education, the standardisation of compulsory schooling has also received much attention. Hence, in 1977, it was decided on the national level that all lower secondary schools should be made uniform (le college unique)*:* the curriculum followed by a student of that age is the same regardless the career path envisaged or the type of higher education considered.

Although pedagogical structures are standardised and knowledge to acquire is precisely stated in the curricula, there is strong reticence about establishing standards concerning skills [3]. A series of reports have been published to engage reflection on teaching contents and related skills (Lesourne 1988; Ministère de l'Education Nationale 1994). These reports converge on the establishment of a common plinth of knowledge and skills (socle commun).

On the 23rd April 2005, a law concerning guidance and curriculum for future schooling was passed. Made up of a set of knowledge and skills, it states that compulsory school should guarantee all its students the necessary means to acquire a socle commun. Accordingly, a new council, HCE, (the High Council of Education) in charge of proposing teaching approaches, curricula, organizing education, evaluation and teacher training was established. The HCE produced a report in March 2006 outlining recommendations for the common plinth of knowledge and skills. In July 2006, a decree, very similar to the content of the report of HCE, stipulating the official content of the socle commun, was published. Since 2007, a calendar has drawn up the main stages of the evaluation of these standards. The main changes for students concern the 'lower secondary school national brevet', which is the first national examination taken by all students. Traditionally, this exam is based on written tests assessing the students' knowledge in mathematics, French, history and geography, and oral tests assessing a certain command of a foreign language, computer and Internet skills. This 'national brevet' will finally take into account the evaluation of the socle in 2011. As it was the first time that a law states guidelines presenting similarities to official curricula (usually not published as laws) and because an official report (written by a new council) had been published few months before, many teachers were puzzled and did not know what document they should refer to in their daily practice.

4. Subjects: The law establishing the content of the socle commun groups the standards according to the seven so-called 'pillars' stated below:

1. Mastering the French language.

2. Practising a foreign language.
3. Knowing the main elements of mathematics and mastering scientific literacy.
4. Mastering the usual techniques of information and communication.
5. Mastering humanistic literacy including history, geography, literature, arts, and music.
6. Acquiring social and civil competences (e.g. being prepared for civil life, evaluating the consequences of one's actions and distinguishing rational arguments from authoritive arguments).
7. Acquiring autonomy and initiative (e.g. finding and contacting peers, consulting resources, making decisions, respecting an assignment).
It appears that standards 1, 2, 3 and 4 are organized around the main teaching disciplines, although those concerning science seem to combine with the mathematic standards. In fact, under the same first heading level, the mathematics and science standards are described under two completely different subheadings. The standards 5, 6 and 7 are related to cross curricula skills and should be assessed at least by two teachers of different disciplines. The seven pillars are subdivided into knowledge, skills and attitudes, for instance:

Knowledge about human beings
- Unity and diversity of individuals (genetics, reproduction)
- Organization and functioning of the human body
- Possibilities offered by the human body
- Influence of human beings on the ecosystem

Skills
- Mobilization of these pieces of knowledge in situations

Attitudes
- Being responsible towards the environment, living beings and health

This example illustrates the strong stress put on health education and sustainable development in the natural sciences curricula. The part 'knowledge' (in the Swiss model called 'domains'), which is still very present in all the pillars, shows the cultural importance of the disciplinary approach that has reigned in France since the beginning of compulsory education.

5. Participants: The distribution of roles regarding curricula development has been studied by Chevallard (1985). He stated that a number of decision-makers are responsible for the interaction between the teaching-learning system and society. In a parody, he calls these decision-makers the 'noosphere', i.e. the sphere that thinks about the educational system. In France, decisions are made by the ministry, which includes a council composed of general inspectors, university teachers specialised in the different disciplines and experts in the economic and administrative domain. What Chevallard wrote in 1985 is still accurate nowadays - in general, and also with regards to the setting of standards. An overview of the composition of official councils shows that science education researchers are not official stakeholders. These councils are mainly composed of general inspectors of the ministry, economical and administrative experts and university teachers.

6. Cooperation between participants: According to a decision maker, who works in education policy and who wishes to remain anonymous, the mechanism of cooperation with any other expert should not officially appear in final reports, curricula or recommendations. Unfortunately, this is an opaque mechanism in which research in science education is not officially invited, even if each member of the council is free to contact any expert he or she thinks important to inform the decisions being made.

7. Competence model: The first document published by the HCE (2006) concerning standards put forward the socle commun as a minimal level of knowledge and skills that students must attain at the end of compulsory school. These standards are introduced in an interdisciplinary perspective and are then adapted according to the seven pillars and lead to anchor the reform of teaching methods and assessments in a disciplinary perspective. Actually, a year later an experimental grid for the assessment of skills related to mathematics, technology and science was published. This grid provides the teachers with assessment instructions in relation to teaching levels. Moreover, these instructions do not exactly correspond to the skills stated in the socle: they have been reformulated and reorganized.
The formulation of instructions shows an evolution towards traditional teaching-learning methods that had already been applied during the 1970s, such as the educational objective and teaching method inspired by Tyler (1949). This perspective is confirmed by the last document published concerning the official instructions for the competences assessment (Ministère de l'éducation nationale 2009).
The proposed assessment corresponds to a series of steps students have to master, with a growing complexity of different steps. Table I below provides an example of two skill progresses:

Skill	level at grade 6	level at grade 8	level at grade 9
Following a protocol.	The student follows a simple protocol respecting security rules.	The student follows a simple protocol that is given with a small part of autonomy, respecting security rules.	The student follows a simple protocol he does not know, or a more complex one he already knows.
Proposing a method, a calculus, an experiment, an adapted tool; making trials	The student puts the different steps of the protocol in the right order by way of a reasoning method, a formula or techniques.	The student identifies a method corresponding to the given questions or hypotheses. The student recognises the context or the conditions in which to apply the formula and protocol. The problem having been stated and the protocol given, the student explains what he will do when handling devices.	The student adapts a protocol to similar situations. The student participates according to the conception of the protocol. Having clearly identified the problem, the student proposes a well known protocol. The student uses an essay-error method, applying rules and formula. Having been given the protocol, the student knows what results are expected.

Table I: progresses of two skills given in the official grid for students' evaluation

It is striking to note that since 1995 until now, none of the published documents in France have proposed an explicit model of competences although the general inspection of the national education knew the models employed in other countries and even published an official publication on them (Houchot & Robine 2007).
Nonetheless, some definitions and leanings are given in the latest disciplinary instructions published in 2009 and as a result the learning model became implicit for all teachers from 2005 to 2009. In September 2009, the document titled "vade-mecum" (Ministère de l'éducation nationale 2009) stated some elements explaining choices made four years ago concerning the interest of promoting investigations in the science classroom to foster skills. The preamble of this document

mentions the weak results obtained by French students in PISA evaluations, especially in 'complex tasks'. These tasks are defined as tasks which include several questions combined in one situation that in many cases is based on everyday life. A solution is then proposed, not as a final aim, but as a first step to help students solve these complex tasks: the breakdown of these complex tasks into simple tasks. In the proposed solution, we recognize, yet again the underlying hypotheses of the mastery learning method, namely that akin to a behaviourist approach. Notably, the manner in which students overcome simple to complex solving tasks is not specified.

8. Skills and knowledge: Two documents should be used as reference by the teacher as a basis for organizing their teaching content: the curriculum and the socle commun. Both documents make reference to each other either for skills (in the French document compétences) and elements of knowledge. For instance, the method advocated in the curriculum takes into account the skills aimed by the socle, such as: formulation, argumentation, observation and presentation of results. Table II draws a comparison of information given in the two official documents addressed to teachers, in terms of knowledge and skills.

	Curricula	*Socle commun*
Knowledge	Some behaviours (lack of physical activity, overindulgence of fat, sugar, salt) favour obesity and nutritional diseases (cardiovascular diseases, cancers)	Master knowledge on human beings - organization and functioning of human beings - the human body and its potentials
Skill (in French compétence)	Observe, make an inventory and organize information in order to link up indulges and diseases	Mobilize one's knowledge in the given situation, for instance understand the functioning of students' own body and the effects of eating. Act to combat negative effects on their body by doing physical activities such as sport and be aware of natural, professional or domestic incidents.

Table II: The comparison of instruction given in the curricula and the socle commun in terms of knowledge and skills based on the theme 'human responsibility concerning health and environment'

From this table, we can see that some incoherencies appear when juxtaposing the two types of instructions. That is, the knowledge formulated in the curricula is closer to the skills than to the knowledge described in the socle commun. This can lead the teacher to consider that these documents are either impractical or think the new instructions as unnecessary.

9. Levels: The socle commun has been built in continuity from primary up to the end of lower secondary school. The French lower secondary school is organized in three so-called cycles: adaptation (grade 6); central (grade 7 and 8) and option (grade 9). The students can only repeat the last year of a cycle, i.e. grades 6, 8 and 9. Physics instruction starts at grade 7 whereas biology, mathematics and technology are taught from the beginning of grade 6.
At the end of grade 9, students take the exam of the national brevet. Since 2007, this exam attests that students have reached the level of knowledge in science required at grade 9. The tests of the

national brevet also include some written exams in mathematics, French, history and geography. In addition, the level in foreign language is tested too, as well as ICT competences. In the document vade-mecum published in 2009 (Ministère de l'éducation nationale 2009), the three levels of skills indicated correspond to the end of the three teaching cycles of lower secondary school. During 2010-2011, modalities to validate the national brevet change.

10. Validation of the model / tests: A number of tools to evaluate students' skills was developed and proposed to teachers between 2008 and 2009. None of these tools have been actually implemented due to the unofficial status of assessment procedures. The only national testing organized by the ministry of education, in partnership with the local education offices, consisted in asking some schools to work on the formulation of each item. During this time, specifications tested the understanding of items by the teachers but not to test the items with students. The results of these testing procedures have not been published.

11. Implementation: The process engaged in the French system starts with the publication of two types of instructions: traditional curricula and an official decree, the socle commun. The decree declares that compulsory school should guarantee for all students the necessary means to acquire a basic knowledge and a certain number of skills. In this perspective, the assessment of skills should become a necessity that consequently changes the nature of assessment that is usually carried out. For instance, during the year 2010-2011 the national brevet, which attests to the level expected at the end of compulsory school i.e. grade 9, will integrate the validation of each skill. The way it will be implemented is delegated to each teaching region. Some training sessions have been planned, but these depend very much on the predisposition of the inspectors' and local education officers. Given that no experimental validation was planned, the adjustment period corresponds to the national implementation of this new evaluation grid. Indeed, during the school year 2010-2011, the teachers have to gain an awareness of these grids and simultaneously prepare and evaluate their students for their first national exam.

12. Research and development projects: Regarding the tools to evaluate the skills listed in the socle commun, science education researchers or teachers have carried out a number of research-development projects. However, these local experiments do not have any impact on national policies. Another trend in research deals with critical secondary analyses of PISA results, questioning the links between the outcomes of PISA tests and the evaluation of skills (see for example, in the domain of French reading and writing literacy, Bautier, Crinon, Rayou & Rochex 2006).

(3) Similarities and differences between the Socle and HarmoS

1. History of education systems: With regards to the history of their education systems, Switzerland and France impart nearly opposite characteristics. The Swiss education system moves from a federalist organization that gives sovereignty to the diverse educational choices of the 26 cantons to an obligation to collaborate in favour of harmonization. For more than two centuries, the French educational system has been anchored in a centralized tradition, in which decisions made by a single ministry have to be implemented irrespectively of local characteristics of schools. The ideology underlying this tradition is that compulsory school is the cement of the nation that must propose the same teaching content to any student, in any school throughout the country.

2. Reasons for setting standards: While the two countries are very different in terms of their history of education, there are many similarities with regards to the reasons to set standards. The treaty of Lisbon initiates new perspectives for compulsory school as a necessary premise to life long learning. These perspectives go hand in hand with publications of international evaluation results classifying the countries on the basis of success of students to competence tests. In this general political frame, in France as in Switzerland, the creation and definition of standards aim to promote the comprehension of requirements linked to international evaluations such as PISA. Those standards are also a step towards cross curricula skills that compulsory school has to transmit. Moving from knowledge assessment to competence standards allows both countries to come within the scope of European and worldwide levels and constitutes a further step in the globalisation of science education.

3. Main steps: The main steps in setting the standards depend on each country. The elaboration process in Switzerland relies on a back and forth between political phases and scientific phases in which all the decision makers and researchers are known. Moreover, a previous review of literature, foreign experiences and reform projects helped to define and adopt the elaboration process to the Swiss situation. Adjustments of the skills and domains have been made as a result of experimental phases, in order to publish standards matching the actual potential of students for each stage. The idea in this case was not only to raise the level of students but to find a consensus to harmonize the national teaching objectives on the basis of international education policies and theoretical arguments.
In France a nationwide school system that should be developed and improved already exists. The ministry as an institution, in which individual decision makers do not have to be recognized, has internally processed the international perspectives. As a result of this process, a law setting the French standards has to be enforced by the teachers. The content in this case is not explicitly based on a scientific analysis, but on general acknowledgments concerning pupils' results to international evaluations and reaffirmation of the role of compulsory school as the cement of the nation.

4. Subjects. In France, the approach to the standards is very broad and constitutes a real base for all the students to insure social integration and life long learning. In this perspective, all except for physical education disciplines have been considered. Within the seven pillars, there appears to be an intention either to find connections between the disciplines, the advocated methods (in relation to the official curricula), multidisciplinary themes or complex problems that have to be addressed. Once again, the strong influence of the PISA results is felt through arguments concerning the complex situations of those PISA-tasks that French students failed to solve. In this perspective, cross curricula skills are supposed to be the cement that allows pupils to become educated citizens.
In Switzerland the standards are much narrower than in France: at the moment they lay down four subjects, cross curricula skills are not considered. Nevertheless, the four subjects are a starting point for the process of harmonization and are perhaps easier to implement than cross curricula skills. In Switzerland, the idea was to take the benefits of international policies to reorganize the disciplines. Despite the differences, in both countries, the disciplinary approach is still extensive. Moreover, both countries integrated in these standards themes that have to be discussed regarding several disciplinary approaches, such as sustainable development.

5. Participants

Differences are considerable: going from a complete opacity of the process of construction in France to a relatively transparent one in Switzerland. In the first case, those responsible for the project at the Ministry of education were surrounded by a group of experts whose names are, however, not published. In the second case, the CDIP proceeded by public invitation in order to group experts from the three linguistic areas in scientific consortia. Throughout their work, they communicated regularly to different public. Finally, the standards of education proposed by these consortia have to pass a broad consultation by all concerned institutions before the political decision makers definitely adopt them.

6. Cooperation

Although cooperation is also evident in France (particularly during the establishments' experimental phases in the schools) it is impossible to identify precisely what it encompassed because it is not mentioned in the publications. However, one can conceive that the degree of cooperation did, nonetheless, have some impact on the official socles. In Switzerland, by identifying the scientific consortia, a broad participation of varying intensity with different participants within the educational field was ensured. As well as the organization of an annual conference, collaboration included partnership with many experts and practitioners who were regularly consulted. Nevertheless, whatever the degree of cooperation realized is, it is important to know who establishes under which legitimacy and influence the final and official version of the standards.

Standards in Science

7. Competence model

While standards in Switzerland are founded on a defined model, France chose to establish a knowledge and competence based framework which provides a definition of competences as a set of abilities, knowledge and attitudes. In fact, in both countries scientific knowledge, scientific skills (and in France cross-curricular skills), and levels have been developed and explained in detail, as will be shown in the next paragraphs. Many of the skills that are described in France and Switzerland are similar. However, what differs is the representation of the underlying model: in Switzerland the model is represented in a diagram in a three dimensional matrix, which provides an overview from which one can draw in from a top-down-approach more detailed information and interrelations between the different axes. In France the information about knowledge, skills, levels, and the relations between them is spread over different chapters and documents, respectively, in each disciplinary curriculum.

8. Skills and knowledge

From the perspective of skills and knowledge, there are strong similarities between the French and the Swiss approach: both distinguishing between knowledge and skills, describing similar knowledge and similar skills. For example, in France and in Switzerland students should be able to 'ask questions and to investigate', 'to organize information', 'to present and to communicate' or 'to work self-reliantly'. In both countries, they should acquire similar knowledge, e.g. in the field of 'human beings' they should know the basic concepts and ideas in 'organization and functioning of the human body, in reproduction and genetics'. At least at this general level the similarities are immense, however, at a more detailed level there may be more differences which have not been analysed in this study.

9. Level

In both France and Switzerland the policy makers have set almost identical frames with regards to the levels. Particularly, two characteristics are identical: I) the levels and therefore the standards are defined as a common socle, i.e. as basic standards to be attained by the large majority of students. II) There are standards that are defined at the end not only of one grade but of several grades, in Switzerland 2, 6, and 9, in France 6, 8, and 9. The underlying idea is the graduation of a skill, its continuous development in the course of several years.

Whereas the French socle commun focuses, at least in science, only on lower secondary school and basic standards, the Swiss model includes the mandatory school as a whole. Additionally, it describes - besides the basic level for the end of grades 2, 6, and 9 - also higher levels for medium and high performers (see figure 2).

10. Validation

In France validation has consisted a small member check, i.e. the ministry consulting some teachers. In Switzerland the validation has included a qualitative and quantitative approach, i.e. a broad member check and several tests. The tests have been performed at the end of grades 2, 6, and 9. They have included both paper&pencil and performance problems. The empirical results allowed the determination of the status quo of students' skills and knowledge, proposing basic standards, and yielding paradigmatic examples of problems.

11. Implementation

In the two countries, the standards serve as reference for evaluation. In France, this process is centralized. Since 2010, a computer software allows the recording of the pupil's results according to their capacities and knowledge of the socles. With this database, accessible to all academic networks, the local and national authorities will be able to describe the recent situation or make comparisons between establishments. In Switzerland, the educational standards will first of all be integrated in the curricula of each linguistic area, having the possibility of building tests of references based on the regional curriculum. On the national level, an evaluation of the system's effectiveness with a representative sample of pupils will probably be taken into 2014. The results are published every four years within a vast national report compiling the quantitative and qualitative information available. However, the standards cannot be used to evaluate establishments nor teachers.

12. Research and development

One common research focus is the evaluation of competences, i.e. the development of specific instruments to diagnose students' skills and knowledge. In France this research focus also encompasses secondary analyses of PISA results from the perspective of the common socle. In Switzerland the spectrum of research is broader, including the modelling, description and promotion of specific skills that have, as yet, not been sufficiently elaborated. In addition, it includes programmes for professional teacher development in order to implement the idea of competences and standards in daily instruction.

This article is focused on science education. Could our results, i.e. the similarities and differences between the Socle and HarmoS, be applied to other subjects? We assume that an analysis of the Socle and HarmoS of mathematics, first and second language learning would possibly lead to results similar to those described above for science.

(4) Conclusions and implications for setting standards in science education

1. Governance

The introduction of an official definition of competences expected to be achieved by the end of a school qualification, i.e. at the end of primary or lower secondary school, in a shorter and more operational way which corresponds to the curricula is a political act already carried out in many European countries (Lawn 2011). The methods to be employed such as which ones would be suitable and how to act at the local level are open questions and topics for further research (see e.g. Altrichter et al. 2010, Klieme et al. 2008, UNESCO 2007).

Since 2000, the comparisons of the results from PISA reinforced in Europe the need for governments to specify the basic requirements in certain key disciplines. Many countries of Western Europe are engaged, including France and Switzerland. The differences in the methods of piloting and in the procedures between these two countries stem from a radically different system of governance. Nothing states up to now that one of the two procedures is more effective or relevant than the other, if not that transparency and empirical bases increase in general credibility and acceptance of the official directives. From a didactic point of view, this transparency passes by the publication of preliminary results and the indication of the sources, references and specific studies used, so that the experts of a discipline know what to refer to. Switzerland has better realised this aspect than its large neighbour.

2. Towards a globalization of the concept of scientific literacy

As pointed out respectively in paragraph 7, competence model, and 8, skills and knowledge, there are many similarities between the French socle commun and the Swiss HarmoS project. Although the structures in the two countries are very different, the concept of scientific literacy is rather similar. To elaborate, in France and in Switzerland one distinguishes explicitly between competences (in Switzerland called skills) and knowledge (in Switzerland referred to as domains). Comparing the competences one can find almost identical descriptions. A paradigmatic example is the skill 'to ask questions and to investigate'. There might be two reasons for the similarities:

- The sciences are characterized by a clear system, a trait that is quasi inherent to them. This trait refers to the contents and the methods. Competence models and curricula are - to a certain degree - a mirror of the system of the sciences.
- There is an ongoing international exchange between science educators, curriculum developers, and policy makers of different countries. Working together in large international studies such as PISA (since 2000), they meet at international conferences, e.g. the bi-annual conference of the 'European Science Education Research Association' (founded in 1995), and publish in international journals. The international cooperation and exchange has led to a reconciliation of views about science education.

3. Integrating different perspectives

In both countries, each stakeholder has been consulted at various stages. In Switzerland, research has made significant contributions in order to develop a competence model, to produce tests, to validate the model and, finally, to propose standards. In France, the research community has not officially been invited to contribute during the early stages of the elaboration of standards. The approach in setting standards is grounded in political debates, including international evaluation, and has excluded teachers' and the research community's expertise. In the light of the difficulties encountered in each country, it seems necessary to take into account both of these perspectives (political and empirical) to avoid a strong rejection of the communities interested in education.

Independent of the chosen approach, it appears that teachers are the main contributors of the success of the implementation of standards. The French decree in 2006 could be viewed as the means to pressurise teachers to teach and evaluate their students on the basis of standards. However, this has only been considered in part when the national exam was officially changed coupled with the publication of adapted software to capture evaluation. This fact shows that in order to change teachers' practises, it is absolutely necessary to propose teaching and evaluation tools, and to change curricular perspectives.
Nevertheless, this is insufficient given that to optimize the implementation process and to guarantee the validity of the chosen standards, it is also necessary to include research perspectives, as has been done in Switzerland. This perspective anchors the political decisions in a tested and recognized knowledge base that could enable to keep political decisions at a distance avoiding spontaneous rejection of educational changes.

4. A model structuring skills, contents, and levels

In both countries, a model has been developed that includes skills, knowledge and levels. In Switzerland the three-dimensional matrix provides an overview of the skills similar to tables in France. Typical for both models is the progression within one skill, from grade 2 to 9 in Switzerland, from 6 to 9 in France. The description of the progression is a key element in both models and helping to structure the learning of science.
Despite these similarities, the number of levels is different, in France there are three levels, i.e. one for grade 6, 8, and 9; in Switzerland nine levels throughout the time of compulsory school. Whereas in France only lower secondary school is included, in Switzerland it is compulsory school as a whole. We propose the development of competence models that also include the upper secondary school (see for example the Canadian and the US frameworks, CMEC 1997 and NRC 1996) and perhaps to re-examine the levels given that three levels may be not be enough whilst nine levels too much.
Three of the seven pillars in the socle commun are dedicated to cross curricular skills whilst in HarmoS these skills play only a minor role. We suggest integrating these skills in projects such as HarmoS or the socle commun, and relations should be made between them and subject specific skills and knowledge.

5. Validation of standards

Standards should be valid, realistic, and credible; otherwise they will not by accepted by teachers, parents, students and other stakeholders. A broad member check and a large trial can contribute to credibility and acceptance, but cannot answer the question as to whether the standards are realistic and valid.
It seems necessary to us that levels and standards - before they are proposed or are enforced - are validated by empirical tests with representative samples. This kind of quantitative validation enhances the chance of defining standards, which are realistic, valid, and credible. Furthermore, the problems of the test can be used to illustrate levels and standards.
The decision whether basic (minimal) or regular standards should be developed, validated and defined is a political question. In France and in Switzerland policy makers adopted basic standards, whereas in other countries, e.g. Germany and Austria, regular standards are in force.

6. Development and Implementation

Financed by German-speaking countries, and in view of their expertise, Oelkers & Reusser (2008) insist the implementation of standards or socles that link to the curricula. The implementation should incorporate the various levels of responsibility and evaluation of the education system, the

development of programs and teaching materials, the training and coaching of teachers and collaboration in the establishments between teachers. It will still be necessary to wait a few years until the implementation of such directives is effective and the measurement of the influence of the national standards provides useful indicators to pilot the system. In each country there are various possibilities to make use of it by the various members within the political and educational system and to benefit from the information collected in their acting sector. Though the feedback culture remains unquestionably one of the most important aspects of the piloting, it is, in fact, not the easiest factor. It will also be necessary to reflect and analyse the results obtained, in particular by correlating them with those of other school disciplines and with contextual data received from the same pupils. All this takes time, as one observes well with the PISA studies which gain interest from their periodic repetition. However, the teaching and scientific diary is slower than the political diary. For this reason, we recommend the preparation and announcement of an official planning, in order to confirm priorities and to start the process.

7. A broad field for research

After a period during which researchers rejected or at best ignored the standards and international evaluations, it appears that these injunctions have led to new practices concerning teaching and evaluating the learning of science. New areas for research are ipso facto open for research and should also lead to new perspectives in teachers' initial and in-service training.

Undoubtedly, integrating standards in everyday teaching and evaluation practices will require some time. The formulation of these standards should certainly be changed in order to be well understood or to fit with the actual abilities of the students. Researchers, in collaboration with teachers, administrative management teams and policy makers, might improve the follow-up of this process.

The ways in which standards can be implemented at the local level as well as how they can be controlled are two of the main research problems. The implementation of these standards is a highly complex problem involving the many different stakeholders - i.e. school administrators, teachers, students, and parents and their co-operation, mutual interaction and interdependence.

As we have tried to show in this paper, the implementation of standards should also take into account the benefits of the comparison of international perspectives, even if the manner in which standards are chosen, validated, and implemented are culturally anchored in the history of education of the different countries.

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Endnotes

[1] For the Swiss model it would be more suitable to say 'skills and domains'. But as in France, and in many other countries, one talks of 'knowledge' instead of 'domains', ‘knowledge’ is the term we have chosen to use.

[2] The first and the eighth 'skill' are not really skills, in other competence models one talks of 'domains of competence'. In the Swiss model we prefer skill (in the original languages, German and French, 'Handlungsaspekte' and 'domaines d'action'), in order to be able to distinguish between skill, domain, level, and competence.

[3] In the French documents one talks of 'compétence'; there is no distinction between the skill and competence as they have been defined in the Swiss model. In order to be coherent in this article, we distinguish between the terms skill and competence. As a consequence the French word compétence has been translated to skill, and the term cross curricula competence has been changed to cross curricula skills.