# National Curriculum Parameters

## Secondary Education

Federal Government

Ministry of Education

## Chapter I

1. The New Secondary Education

The Minister of Education, through the Secondary and Technological Education Secretariat, has organized the Secondary Education Reform Project as part of a broader social development policy that attaches priority to actions in the field of education.

Brazil, like other Latin American countries, is committed to promoting educational reforms that will make it possible for the nation to overcome significant disadvantages vis-à-vis the schooling rates and the level of knowledge of developed countries.

With respect to Secondary Education in particular, two factors of a very different nature, albeit with observable correlations, have determined the pressing need to revisit the overall guidelines and curriculum parameters that serve as the underlying guidance to this level of education.

Firstly, the economic factor, as it stands, is defined by technological strides that are characteristic of the so-called third technical and industrial revolution, in which breakthroughs in microelectronics have played a key role, and which has become all the more pronounced in this country as of the l980's.

The so-called "information technology revolution" has brought about radical changes in knowledge-related fields, with knowledge taking on a pivotal role in development processes, broadly speaking. It is fair to state that over the next decades the educational sector will be changing more rapidly than other sectors, as a result of a new theoretical understanding of the role of schools following the introduction of new technologies.

The proposed curriculum reform for Secondary Education is based on findings about the changes in knowledge and their implications as regards production processes and social relations in general.

In the 1960s and 70s, taking into account the level of industrial development in Latin America, the educational policy then in effect stressed, as the express purpose of Secondary Education, the training of specialists able to master and use machinery or spearhead production processes. This trend led Brazil, in the 1970's, to propose mandatory professional training education, a strategy that was also aimed at lessening the pressure stemming from the demand for Higher Education.

In the 1990s, we faced a different challenge. The amount of information produced as a result of the new technologies increased constantly, thus determining new parameters for

the professional schooling of citizens. It was no longer a matter of simply accumulating knowledge.

Student development must be ultimately targeted towards the acquisition of basic knowledge, **scientific preparation and one´s ability to use different technologies pertaining to one's field(s) of activity.**

In Secondary Education, the proposed focus now emphasizes general training, as opposed to specific training; the development of one's ability to research, seek out information, analyze it and select it; the ability to learn, create, formulate, as opposed to a mere exercise in memorization.

These are the broader principles underlying the Secondary Education curriculum redesigning that are enshrined in the new Law on Brazilian Education Guidelines and Bases – Law 9,394/96.

If, on the one hand, it is necessary to give thought to curriculum reforms taking into account the structural changes that have modified production processes and social organization itself - which we have termed the economic factor -, it is equally important, on the other hand, that one be knowledgeable of and able to assess the conditions in which Brazil's educational system has developed.

In Brazil, Secondary Education has expanded the most as of the 1980's. From 1988 to 1997, the growth in the demand for Secondary Education exceeded 90% of the enrollment rate up until then. In the period of one year alone, from 1996 to 1997, the enrollment rate for Secondary Education grew by 11.6%.

It is noteworthy, however, that the net schooling rate for this level of education, for the population in the 15 to 17 age group, is no more than 25%, which places Brazil in a situation of inequality vis-à-vis many countries, including some in Latin America.

In the Mercosur countries, the schooling rate currently stands between 55% and 60% and in most English-speaking countries of the Caribbean it is close to 70%.

The growth pattern in Secondary Education enrollments in Brazil, however, has certain characteristics that make it possible for one to highlight its relations with the changes that have taken place in society.

Enrollments are concentrated in the state level public educational systems and in night shift courses. Studies carried about by the National Institute for Educational Studies and Research (INEP) as part of an assessment of students completing Secondary Education in

nine states show that 54% of students come from families with a monthly income of up to six minimum wages, the equivalent of approximately 450 US dollars.

It is thus possible to infer that the social segments that were up until then excluded from educational services have had the opportunity to continue their studies upon completion of the Elementary Education cycle, or that this same segment is now going back to school, given a realization of the importance schooling has taken on, in view of the emerging demands from the labor market.

Designing a new curriculum for Secondary Education brings to the fore these two factors: **the structural changes stemming from the so-called "knowledge revolution", thus changing the mode of labor organization and social relations; and the increasing expansion of the public school system, which must now keep quality standards in line with the demands of society.**

2. Secondary Education as the final stage of Basic Education

The Law on Brazilian Education Guidelines and Bases (LDB) sets forth that Secondary Education is "*the final stage of basic education"* (Article 36) which contributes to the construction of its identity as such. Secondary Education has taken on the feature of being an end stage, which means ensuring all citizens the opportunity to consolidate and deepen the knowledge acquired in Elementary Education; improving students' status as human persons; making it possible for studies to be continued; ensuring basic preparation for work and citizenship; endowing students with the tools required to "continue to learn", considering the development of one's understanding of the "*scientific and technological foundations of production processes*" (Article 35, subparagraphs I to IV).

Secondary Education, therefore, is the end stage of a general purpose education, in line with contemporary developments, with the construction of basic competencies that will allow students to become subjects who are producers of knowledge and participants in the world of labor, as well as in line with students´ personal development as "situational subjects", i.e., citizens.

From the perspective of the new law, Secondary Education, as part of school-based education, "*must be linked to the world of labor and to social practice"* (Article 1, Paragraph 2 of Law 9,394/96). This intrinsic link should pervade all school-based educational practice.

In sum, the law establishes a practical prospect for this level of education that will integrate into one same mode the purposes which up until then were kept separate, so as to provide balanced education with equivalent roles for all students, in a fully coordinated fashion:

- personal development so as to foster values and competencies required, integrating one's individual project to that of the society in which one lives;
- students' enhancement as human persons, including training in ethical values and the development of intellectual autonomy and critical thinking;
- preparation and basic guidance for one's integration into the world of labor, with the competencies that will guarantee one's professional improvement and make it possible for one to keep up with the changes that are characteristic of current production processes;
- the development of competencies required for continuous learning in an autonomous and critical fashion at more complex study levels.

## 3. The role of education in a technology-based society

The pivotal role of knowledge in production processes and in the organization of social life breaks away with the paradigm according to which education would be taken as an instrument to "shape and suit" the future professional to the world of labor. Discipline, obedience, strict compliance with rules established, which up until recently were requirements for social inclusion via professional development, have now become irrelevant in view of the emerging requirements brought about by technological and social development.

The new society resulting from the technological revolution and its implications to production and information-related processes has features that can ensure an unprecedented level of autonomy to education. This is so as the development of the cognitive and cultural competencies required for full-fledged human development has now coincided with production-related expectations.

The new paradigm stems from the understanding that the competencies that are desirable for full human development are increasingly similar to the requirements for one's inclusion in the production process. According to Tedesco, to accept this optimistic perspective is to admit that we are going through "an unprecedented historical circumstance, in which one's abilities for productive development are identical to those required for one to perform one's role as citizen and for social development". In other words, by acknowledging such correlation between the competencies required for the exercise of citizenship and for production-related activities, the role of education as an element of social development once again gains a high profile.

What competencies are we talking about? One's ability to sustain abstract reasoning; the development of systems-based thinking, as opposed to a partial and fragmented understanding of phenomena; creativity, curiosity, the ability to think of multiple alternatives to solve a given problem; in other words, the development of diverging thinking, the ability to work in teams, the willingness to seek and accept criticism, the willingness to take risk, the development of critical thinking, knowing how to communicate, the ability to seek out knowledge. These are the competencies that ought to be found in the social and cultural sphere as well as in political and social activities as a whole and which are prerequisites for the exercise of citizenship in a democratic context.

The challenge to be faced is indeed a major one, especially for a developing country which, in the 1990's, did not even provide Secondary Education coverage as part of Basic Education to more that 25% of its youth in the 15 to 17 age group.

A new curriculum concept for Secondary Education must reflect contemporary developments and, considering the speed at which changes have occurred in the fields of knowledge and production, it must be bold enough to take a forward-looking approach.

In order for the implementation of the curriculum reform currently under way to become effective, it is necessary to invest in macro-planning with a view to rationally expanding the number of vacancies offered. It is likewise critical to invest in teacher training, as the measures proposed call for changes in terms of selection, treatment of contents and introduction of modern technological tools, such as information technology.

These are some of the priorities highlighted in all of the studies recently conducted by the Secondary and Technological Education Secretariat and the National Institute for Educational Studies and Research (INEP) through the National Basic Education Assessment System (SAEB) and which have contributed to the development of the proposed curriculum reform.

In traditional societies, the stability of the political, productive and social organization used to guarantee a relatively stable educational environment. Nowadays, the rate of scientific and technological progress and the transformation of production processes mean that knowledge is rapidly updated, thus requiring continuous refresher training and updating and posing new demands as regards citizens´ full development.

In view of today´s globalized world, one which poses multiple challenges to humankind, education emerges as a utopia not only necessary but at the same time essential to humankind in its pursuit of peace, freedom and social justice. It must be viewed,

according to a Report by UNESCO´s International Commission on Education for the 21st Century, *"among other paths and beyond them, as a pathway leading to a more harmonious and more authentic development, so as to do away with poverty, social exclusion, [sources of] incomprehension, oppressions and wars"*.

Considering such a context, we have sought to develop new curriculum organization alternatives for Secondary Education that are committed, on the one hand, to the new meaning of labor in the context of globalization and, on the other hand, to active subjects, human beings that will incorporate this knowledge so as to improve themselves in the world of labor and in social life. It is therefore necessary to break away from the traditional models in order to accomplish the proposed objectives of Secondary Education.

The perspective taken is one of ongoing learning, continuous development, considering the construction of citizenship as a function of changing social processes to be a key element in students´ development.

In view of the above, it is important to highlight the considerations by the International Commission on Education for the 21st Century, as written into the provisions under Law 9,394/96:

a) education must fulfill a three-fold purpose: economic, scientific and cultural;

b) education must be structured upon four foundations: learning how to know, learning how to do, learning how to live and learning how to be.

## 4. Curriculum reform and the organization of Secondary Education

The curriculum, as an instrument of democratic citizenship, must contemplate contents and learning strategies that empower human beings to carry out their activities in three different spheres of human action, namely, **life in society, productive activity and subjective experience**, with a view to integrating men and women in the three-fold universe of political relations, labor and subjective symbolization.

From this perspective, the four premises pointed out by the UNESCO as the structural axes of education in contemporary society, namely, **learning how to learn, learning how to do, learning how to live and learning how to be** are incorporated as the overall guidelines underlying the proposed curriculum.

Based on these general principles, the curriculum must be coordinated along the basic axes determining the selection of significant contents aimed at the target competencies and skills to be developed in Secondary Education.

- **The Common National Base**

It is in the context of Basic Education that Law 9,394/96 establishes the curriculum designing for Elementary and Secondary Education *"with a Common National Base to be complemented in each school educational system by a diversified portion, as required by the features of the local and regional society, culture, economy and clientele"* (Article 26).

The Common National Base contains the elements conducive to one's preparation for the continuity of studies and, as such, it should be implemented so that the development of basic competencies and skills, rather than the mere accumulation of previously established problem solving arrangements, will be the ultimate objective of the learning process. It likewise contains the elements conducive to one's preparation for work. Underlying and interrelating the different social contexts and practices beyond work, it requires, for example, that Biology provide the foundations for an analysis of environmental impacts, as a given technology solution or for the prevention of an occupational disease. In sum, it underscores the fact that, on the one hand, there is no technological solution in the absence of a scientific foundation and that, on the other hand, technological solutions can prove instrumental in the production of new scientific knowledge.

The Common National Base is intended for the overall student development and it must ensure that the purposes provided for under law, as well as the target student profile will be accomplished, thus making Basic Education an actual asset available to every Brazilian.

The development of basic competencies and skills common to all Brazilians is in itself a guarantee of democratization. The definition of these competencies and skills will serve as a parameter for the evaluation of Basic Education nationwide.

Article 26 of the LDB Law establishes the obligation to include in this Common National Base: *"Portuguese Language and Mathematics studies, the knowledge of the physical and natural world as well as the social and political reality, especially of Brazil, the teaching of Arts* [...] *in such a way as to promote the cultural development of students, and Physical Education, as incorporated into the school's pedagogical project"*.

It is important to understand that the Common National Base cannot become a straightjacket that curtails systems, schools or students' capabilities to enjoy the flexibility that the law not only allows but also encourages. Such flexibility must be ensured both in

the organization of the contents referred to in the law and in the methodology to be developed during the teaching-learning process and the assessment procedure.

These overall remarks on the law point to the need to develop new alternatives for curriculum organization that are, on the one hand, committed to the new meaning of labor in the context of economic globalization and, on the other hand, to active subjects that incorporate this knowledge and, as such, improve themselves for the world of labor and social practice.

An important caveat to be born in mind is that a national curriculum base organized by fields of knowledge does not mean any disregard for or emptying of contents, but rather the selection and integration of those contents that are valid for the purpose of personal development and the enhancement of social participation. This curriculum concept does not do away with the teaching of specific contents but rather regards them as a relevant part of an overall process that has several closely interrelated dimensions.

- **The three fields of knowledge**

The curriculum reform in Secondary Education establishes a division of school-acquired knowledge into fields of knowledge, as it is understood that knowledge has become increasingly intertwined with those who hold knowledge, be it in the technical and scientific arena, be it in every-day social life. The organization of knowledge into three fields of knowledge, namely, Languages, Codes and Related Technologies, Natural Sciences, Mathematics and Related Technologies and Human Sciences and Related Technologies, is grounded upon the clustering of types of knowledge that share a given subject of study and, therefore, communicate more easily, thus creating the conditions required for school practice to evolve in an interdisciplinary approach.

This structuring by field of knowledge is justifiable inasmuch as it ensures an educational practice based upon scientific and technological underpinnings, in which concept application and concrete problem solving are combined with a revision of the social and cultural components informed by an epistemological vision that reconciles humanism and technology or humanism in a technology-based society.

Personal development pervades the concept of the scientific, technological, social, cultural and language components. The concept of science is also found in the other components, as well as the understanding that the production of knowledge is socially, culturally, economically and politically situated in space and in time. It is relevant to acknowledge the historical nature of the knowledge production process. In sum, it is recommended that the curriculum design concept be transdisciplinary in nature and

matrix-based, so that the hallmarks of language, sciences, technologies and, furthermore, historical, sociological and philosophical knowledge, as knowledge that makes possible a critical reading of the world, will indeed be found throughout the school practice.

The fact that these Curriculum Parameters have been organized in each of the different fields of knowledge by potential courses does not mean that they are mandatory or even recommended. What is mandatory under the LDB Law or under Resolution 03/98 is the knowledge content that these courses impart and the competencies and skills pertaining to them, as referred to in the above-mentioned document.

A description of each of the different fields of knowledge will be presented later in the relevant chapter, containing the skills and competencies that students are expected to attain upon completion of Secondary Education.

**• Interdisciplinarity and Contextualization**

By organizing the curriculum into fields of knowledge and on the basis of an understanding of the transdisciplinary and matrix-based concept that brings together languages, Philosophy, natural and human sciences and other aspects of technologies, it is our intention to contribute so as to gradually overcome the self-contained, overly fragmented treatment that has characterizes school-acquired knowledge.

The current trend at all levels of education consists in analyzing the segmented reality, without developing an understanding of the multiple kinds of knowledge that are intrinsically related and which, as such, suit certain phenomena. Confirming this segmented vision is the merely disciplinary approach which, in the new proposed curriculum reform, we intend to overcome in light of an interdisciplinary perspective and the contextualization of knowledge.

From the school perspective, interdisciplinarity is not aimed at ambitiously creating new disciplines or fields of knowledge, but rather at using the knowledge available from different disciplines in order to solve a concrete problem or to understand a given phenomenon from different viewpoints. In sum, interdisciplinarity plays an instrumental role. The idea is to make it possible for one to resort to a kind of knowledge that is directly useful and applicable so as to respond to contemporary social issues and problems.

In the proposed curriculum reform for Secondary Education, interdisciplinarity must be viewed from a relational perspective, whereby it is proposed that, through the school practice, interconnections and flows of knowledge be established by means of complementary, converging or diverging relations.

The integration of different kinds of knowledge can create the conditions required for a motivating learning experience, inasmuch as teachers and students will be given the freedom to choose the contents that are more directly related to the issues or problems pertaining to the community´s life. All knowledge is socially engaged and no knowledge can be learned and recreated if it is not part of the concerns likewise shared by other people. The gap between the syllabus contents and the students' experience clearly accounts for the lack of interest and even for the dropout levels that we currently find in our schools. Knowledge contents that are selected *a priori* have tended to perpetuate in school practices, without undergoing a critical reflection by teachers, thus becoming a knowledge repository that more often than not falls into oblivion or one that cannot be applied since its relationships with reality are not known.

Significant learning assumes that there is a reference point that allows students to identify and to identify themselves with the proposed issues. This does not mean one is to work only at the knowledge level that is given by the more immediate context, let alone by common sense, but is rather aimed at generating the ability to understand and intervene in reality in an autonomous and engaging perspective. By proposing a new form of curriculum organization, now working from an interdisciplinary and contextualized perspective, it is assumed that all significant learning involves a subject-object relationship and that, in order for it to materialize as such, it is necessary to provide the conditions for both ends of the process to interact.

**• The diversified portion of the curriculum**

The diversified portion of the curriculum is aimed at meeting the regional and local needs of society, culture, the economy and the target audience (Article 26 of the LDB Law). It complements the Common National Base and will be defined in each school system and ultimately at each school.

From the educational systems´ standpoint, it is represented by the development of a basic curriculum matrix that in actuality implements the Common National Base, taking into account the regional demands from the social and cultural, economic and political viewpoints. It should reflect an underlying curriculum concept that will provide guidance to Secondary Education in the relevant system, thus resignifying it, without nonetheless preventing schools from enjoying flexibility in developing their own curriculum projects.

The diversified portion of the curriculum should express the contents incorporated by the educational systems as well as the priorities set as part of the school project and reflect the students' inclusion in their curriculum development. It must take into account the possibilities of a basic preparation for work and a deeper concentration on a given course or field of knowledge, in the form of courses, projects or modules in line with the interests of the students or those in the community to which they belong. It is important to make it plain that the development of the diversified portion of the curriculum does not mean professional training but rather a diversification of school experiences with the purpose of enriching the curriculum or even further concentrating studies on a given field of knowledge, when and where the context so requires. The main objective is to develop and consolidate field-specific knowledge, in a contextualized fashion, by linking knowledge to social and production practices.

- **Concluding remarks**

These are the issues viewed as pivotal for an understanding of the proposed curriculum for Secondary Education. The information contained in this document is aimed at broadly discussing the key elements involved in the Secondary Education Curriculum Reform. Our intention is to inform the end readers, namely, teachers, education experts and other who take an interest in the issue of education about the key aspects underlying the new concept proposed for Secondary Education.

In the following chapter, the reader will find the theoretical underpinnings for each field of knowledge, as well as guidance on the selection of the contents and methods to be developed in each potential course and the competencies and skills that students are expected to develop and consolidate in basic education.

## Chapter II

## Languages, Codes and Related Technologies

### 1. Introduction

Language herein is viewed as the human ability to express collective meanings in arbitrary systems of representation which are shared and vary according to the needs and experiences of life in society. The main reason behind any act of language is the production of meaning/sense.

It is thus possible to speak of languages that are interrelated in social practices and in history, which means that the circulation of meanings/senses produces different forms of sensitivity and cognition. This involves the assimilation - as demonstrated by the use and comprehension of symbolic systems supported by different underpinnings and tools - of means for a cognitive organization of reality and its communication. It also involves acknowledging that spoken, iconic, body, sound and formal languages, among others, are similarly structured on a set of elements (lexicon) and relations (rules) that bera significance: priority is attached to the Portuguese Language, as the mother tongue that generates meaning and integrates the organization of the world and one's inner self; the mastery of a foreign language(s) as a means to expand the possibilities of having access to other people and other cultures and information; the use of information technology as a means of information, communication and problem solving, to be used as part of the professional and recreational activities, as well as learning and personal management activities; the Arts, including Literature, as a means of expression that dynamically generates meaning/ sense in a given language, and the use of its elements and rules in other languages; physical and sports activities as body mastery and as a form of expression and communication.

It is important to underscore the notion that languages and codes are by definition dynamic and situated in space and time, with all the historical, sociological and anthropological implications that this notion brings with it.

It is likewise pertinent to consider the relations with the social and production practices and the students' inclusion as citizens in a literate and symbolic world. Contemporary production is essentially symbolic in nature and social life requires the mastery of languages as tools for communication and negotiation of meanings/sense.

In today's world, marked by an immediate appeal for information, reflecting about language and its systems, as expressed by multiple codes and based on communicative

processes and procedures, is not just a requirement but also, and more importantly, a guarantee of active participation in social life, i.e., the much aspired citizenship.

The school is the main objective of this text, as it is at school that the convergence between thinking and doing can determine whether or not this initiative will prove successful.

Readers should bear in mind that this document is only advisory interpretive in nature, and thus open to interactivity, dialogue, the construction of meanings and sense in, through and with language itself.

## 2. The meaning of field-specific learning

Language is a social heritage, a "first reality" which, once assimilated, brings individuals together and results in mental, emotional and perceptual structures being regulated by its symbolism.

An understanding of the arbitrary nature of language may allow students to problematize the different ways of "seeing oneself and the world", thought categories and classifications that are assimilated as indisputable facts.

Language pervades knowledge and the different forms of knowing; thought and the different forms of thinking; communication and the different forms of communicating; action and the different forms of acting. It is the invented wheel that mobilizes humankind and that is mobilized by human kind. A cultural product and production, arising by virtue of social practices, language is human and, like humankind, it distinguishes itself for its simultaneously creative, contradictory, multidimensional, multiple and unique nature.

There can be no language in a vacuum; its main objective is interaction itself, communicating with one another within a given social space, as, for instance, spoken and/or written language, a human and social product which, in a coordinated fashion, organizes the data arising from the experiences shared by the members of a given linguistic community.

In today's world, marked by an immediate appeal for information, reflecting about languages and their systems - as expressed by multiple codes and based on communicative processes and procedures - is more than just a requirement; it is the guarantee of active participation in social life, i.e., the much aspired citizenship itself.

The competencies that will be focused on herein relate to a specific field of knowledge and should be developed in the learning-teaching process in the course of Secondary Education. The proposal set forth in this document is not aimed at reducing the amount of knowledge to be learned but rather at defining the limits in the absence of which only with difficulty secondary education students would be able to continue their studies and participate in social life.

- **Field-specific competencies and skills**

**Representation and Communication**

• Contrasting opinions and viewpoints on the different languages and their specific forms of expression.
• Using languages as a means of expression, information and communication in intersubjective situations that require differing degrees of distancing and a reflection about the contexts and status of the speakers involved; and positioning oneself as an active player in the production/ reception process.
• Understanding and using the Portuguese Language as mother language that directly generates meaning/ sense and integrates the organization of the world and one's own identity.
• Applying communication and information technologies at school, at the workplace and in other contexts that are relevant in students´life.

**Research and comprehension**

- Analyzing, interpreting and applying the communicative resources of languages, by establishing a correlation between texts and their contexts, by identifying the nature, function, organization, and structure of language acts, according to the production/ reception conditions (intention, time, place, interacting speakers involved in the creation and dissemination of ideas, and choices, technologies available, etc).
- Recovering, through studies, the established forms of building the collective imagináry, the culturally representative heritage and the classifications that have been preserved and disseminated along the time and space lines.
- Coordinating the networks of differences and similarities between languages and their respective codes.
- Knowing and using current foreign languages as tools of access to information, other cultures and social groups.
- Understanding the principles underlying the communication and information technologies, associating them to scientific knowledge and to the languages that support them, as well as to the problems that they are aimed at solving.
- Understanding the nature of information technologies as a source of integration between the different means of communication, languages and codes, as well as the integrating role they perform in connection with other technologies.

**Social and cultural contextualization**

- Considering language and its forms of expression as sources of legitimization of social agreements and conducts and their symbolic representation as a form of expression of meanings, emotions and experiences of human beings in social life.
- Understanding and using the symbolic systems of the different languages as means of cognitively organizing reality by establishing meanings, expression, communication and information.
- Respecting and preserving the different forms of language expression, as used by different social groups in their spheres of socialization; making use of the national and international heritages, with its different world visions; and constructing differentiation, appreciation and creation categories.

## 3. Knowledge of the Portuguese Language

Under Education Law 5,692/71, this course was split into Language and Literature (with an emphasis on Brazilian Literature). This split was reflected in the curriculum organization: the separation between grammar, literary studies and composition. Textbooks in general and even schools that prepare students for university entry examinations reproduced the same split-based model. Many schools have teachers who are experts in each topic and even teach specific classes as if reading/ literature, grammar studies and text production were not at all interrelated. We have witnessed situations in which the student's notebook was divided according to these segmentations.

The study of grammar appears in curriculum plans for Portuguese since the first grades, but students, up to the final grades of Secondary Education do not necessarily master the grammatical nomenclature. Are the students the one's to blame? Does the grammar being taught make sense to those that know grammar because they are native speakers? The mixup between norm and grammatical correctness is the main problem with the grammar taught at schools. What should ideally be an exercise in speaking/ writing/ reading better becomes an incomprehensible straitjacket.

Literary studies follow along the same line. The history of literature is more often than not the center of reading comprehension; a history that does not always correspond to the text being used as example. The concept of literary text is open to discussion. Machado de Assis is literature but Paulo Coelho is not. Why not? The explanation does not make sense in the eyes of the students.

Given the above, the question as to how to better organize the curriculum for this course in Secondary Education is most certainly a timely one. We are all too aware of just how serious the problems stemming from a basic, instrumental mastery of the Portuguese Language can be, especially the written language that students are expected to have acquired in Elementary Education. However, how is one to solve these problems? A possible diagnosis of what students know and what they do not know should be the starting point in this case. However, the purposes should ultimately be geared towards a broad linguistic knowledge, communication being the foundation of actions.

Communication is taken herein as the process of constructing meanings in which the acting subject interacts socially and uses language as a tool that defines him/her as a person among persons. Language taken to mean the human ability to construct and "deconstruct" social meanings.

Language as situated in the complex network of human relations in which the student is present and deeply involved. Not language separated from the social context experienced. Since language is, by definition, dialogical, it is not possible to separate it from its own nature, not even in the school setting. Since language is the underlying

foundation to all forms of knowledge and personal thoughts, its study requires a transdisciplinary approach in the curriculum.

As far as curriculum choices are concerned, the Portuguese Language Course must be closely coordinated with the field-specific assumptions. Unlike other pieces of legislation that establish a specific workload in the form of number of hours for the course, the Expert Opinion by the National Council on Education (CNE) and Education Law LDB recommend that the minimum number of hours be kept according not only to the school's pedagogical project but also according to the target competencies in each field of knowledge, i.e., the school must decide on the minimum number of hours for the course in light of the school's objective and those set as part of an interdisciplinary approach.

The teaching-learning process for Portuguese in Secondary Education should assume a vision as to the meaning of spoken language. It is characterized as the human and historical construction of a language and a communication system in certain contexts. Thus, the origin of spoken language involves the presence of humankind, its symbolic and communicative systems in a social and cultural world.

Furthermore, it must be based on interaction between language as system and language as faculty, both viewed as part of a discourse process of constructing symbolic thinking, which is a building block for each student in particular and society in general.

This view of language highlights its social and interactive nature, as opposed to the traditional concepts that are shifted away from the social use of language. The work conducted by teachers is focused on the objective of developing and systematizing language as assimilated inwardly by students, thus encouraging the use of spoken language and the mastery of other languages used in different social spheres. The traditional contents in the teaching of language, i.e., grammatical nomenclature and the history of literature, are thus displaced to a secondary level. The study of grammar now becomes a strategy for the comprehension/ interpretation/ production of texts, and literature is integrated into the reading domain.

Many will say that this task should not be confined to the Portuguese teacher alone. Certainly it is a task that involves all courses, but Portuguese may be the one course to spearhead such discussions. Interdisciplinarity may start at this point and, as a consequence, result in the construction and acknowledgment of intertextuality.

- **Competencies and skills to be developed in Portuguese**

**Representation and communication**

- Contrasting opinions and different viewpoints on different varieties of spoken language.
- Understanding and using the Portuguese Language as mother language that dynamically generates meaning/ sense and integrates the organization of the world and one's own identity.
- Applying communication and information technologies at school, at the workplace and in other relevant contexts in students' life.

**Research and comprehension**

- Analyzing the communicative resources of spoken language by correlating texts and contexts, by identifying the nature, function, organization, and structure, according to the production and reception conditions (intention, time, place, interacting speakers involved in the creation and dissemination of ideas, and choices, technologies available).
- Recovering, through the study of literary texts, the established forms of constructing the collective imaginary, the culturally representative heritage and the classifications that have been preserved and disseminated along the time and space lines.
- Coordinating the networks of differences and similarities between spoken and written languages and the relevant social, contextual and linguistic codes.

**Social and Cultural Contextualization**

- Viewing the Portuguese Language as a source of legitimacy for social conventions and conducts and as the symbolic representation of human experiences as expressed in different ways of feeling, thinking and acting socially.
- Understanding the impacts of communication technologies - particularly as regards the written language - on life, production processes, the development of knowledge and social life.

## 4. Knowledge of Modern Foreign Language(s)

Under LDB Law, Modern Foreign Languages to a certain extent regain the importance that they have long been denied. Often and unduly viewed as a not-very-relevant course, they have now gained the status of a course as important as any other in the curriculum from the student's individual development viewpoint.

Accordingly, now a part of the field of Languages, Codes and Related Technologies, Foreign Languages have become an integral part of the wealth of knowledge that is essential to allow students to draw closer to different cultures and, as a result, allow their fully-fledged inclusion in a globalized world.

In Brazil, although the legislation in effect during the first half of the century already pointed out the practical nature that the teaching of foreign languages should have, this has not always been the case. Factors such as the limited number of hours allotted to the study of foreign languages, coupled with a lack of teachers with the linguistic and pedagogical background required, for example, have accounted for the non-enforcement of the legislation. Thus, instead of training the student to speak, read and write in a foreign language, Foreign Language classes at Secondary Education schools ended up taking on a tedious and repetitive overtone, which often deprives both students and teachers of motivation, while failing to appreciate the value of contents that are indeed relevant to the students' educational development.

Foreign Languages at the average school have, therefore, been almost entirely based on the study of grammatical formulae; the memorization of rules and a priority focus on written language and more often that not without any contextual link with the students' reality.

As part of a major field of knowledge – Languages, Codes and Related Technologies – Foreign Languages can now perform their inherent role, which, for a long time, was kept short of evident: that of being essential means of communication among people. Because of their status of a symbolic system, like any other language, foreign languages work as means of access to knowledge and, thus, to different forms of thinking, creating, feeling, acting and understanding reality, which affords students a more comprehensive and more solid training.

It is therefore essential to understand that Foreign Languages are now part of a field of knowledge, and no longer an isolated course in the curriculum. The relations that are established among different forms of expression and access to knowledge justify this inclusion.

From an interdisciplinary perspective that is likewise related to real contexts, the Foreign Languages teaching-learning process has taken on new countours: it now requires actual putting into practice of some fundamental principles that have long remained nothing but ink on paper because they were regarded either as utopian or hardly feasible.

Although it is true that the practical objectives, namely, to understand, speak, read and write a foreign language - as referred to in the legislation and by experts -, are indeed important ones, it would seem that the development-oriented approach that is inherent to the learning of Foreign Languages cannot be neglected. It is therefore essential to approach the school-based teaching of Foreign Languages in such a way as to enable students to understand and produce correct sentences in a foreign language, and to allow learners to attain a level of linguistic competence that allows them to have access to several types of information while contributing to their overall development as citizens.

It is important to think of the teaching and learning of Foreign Languages in Secondary Education in terms of comprehensive, rather than static, competencies, as a language is *par excellence* the "vehicle" of communication of a given people and it is through its unique form of expression that a people conveys its culture, traditions and knowledge.

The world vision of each people varies according to several factors and, as a result, the language also undergoes changes in order to express new ways of looking at reality. Hence the importance of understanding the teaching of a foreign language as being ultimately aimed at providing for real communication, as, in so doing, the different elements that make up communication will indeed prove effective, thus expanding and attaching meaning to the learning process, while doing away with stereotypes and prejudices that will therefore no longer have a place in the classrooms.

Understanding communication as an indispensable tool in today's world, with a view to student's professional, academic or personal development, should be the main goal of the teaching of Foreign Languages in Secondary Education.

- **Competencies and Skills to be Developed in Modern Foreign Language(s)**

**Representation and Communication**

- Choosing the register that is suitable to the situation in which the act of communication takes place, as well as the lexical item that bests reflects the idea one intends to communicate.
- Using the coherence and cohesion mechanisms available for spoken and/or written language production.

- Using the verbal and non-verbal strategies to make up for failure, foster actual communication and attain the intended effect in production and reading situations.
- Knowing and using modern foreign languages as a tool to have access to information, other cultures and social groups.

**Research and Comprehension**

- Understanding how a given phrase can be interpreted by virtue of social and/ or cultural overtones.
- Analyzing the communicative resources of spoken language by correlating texts and contexts and by identifying nature, function, organization, and structure according to the production/ reception conditions (intention, time, place, interacting speakers involved in the creation and dissemination of ideas, and choices, technologies available).

**Social and Cultural Contextualization**

- Knowing how to distinguish between linguistic variants.
- Understanding to what extent sentences produced reflect one's way of being, thinking, acting and feeling.

**5. Knowledge of Physical Education**

This paper is not aimed at indicating one single path to be followed by physical education professionals, but rather at objectively proposing courses of action that will make it possible for all students to develop, and not only the most skilled ones. Bringing Secondary Education students once again closer to Physical Education in a recreational, instructive and contributive fashion in the knowledge consolidation process is the objective underlying the contents set forth in the paragraphs that follow.

LDB Law 9,394/96 sets the specific purposes of Secondary Education: consolidating and further deepening the knowledge gained in Elementary Education; providing continuity of studies; preparing students for work and the exercise of citizenship; developing skills such as continuous learning and the ability to flexibly adapt oneself to new occupational conditions and improvement requirements; improving students as human persons, including the development of ethical values and one's intellectual autonomy and critical thinking; and a comprehension of the scientific and technological foundations of production processes, thus linking theory to practice.

By contrasting the objectives of Secondary Education with those faced in the every day practice in Physical Education at schools, we find ourselves before an inconsistency. While the other fields of study are geared towards a consolidation of students' knowledge through diversified methodologies, contextual studies of the surrounding environment, video presentations, the study of works by different authors, text reading, problem

solving, discussion of current and concrete issues, the classes of the "most attractive" of all components are limited to the well-known foundations of sports and games.

The influence of sports in the school system is such that what we have is not the school's sports but rather sports at the schools. This shows how Physical Education is subordinated to the codes and sense of sports as an institution: Olympic sports, the national and international sports system.

These codes can be summed up as follows: athletic/ sports performance principles, comparison of performance levels, competition, strict regulation, success in sports as being synonymous with victory, rationalization of means and techniques, etc.

This kind of activity determines the relationship between teachers and students, which becomes: teacher-coach and student-athlete. This stance, found in a great deal of Brazilian schools, is the result of the technicist pedagogy that was broadly disseminated in Brazil in the 1970's. A number of authors have addressed this issue, their opinions coinciding as to the need of overcoming this trend.

Physical Education should pursue its identity as a field of studies that is key for the understanding of human beings as producers of culture.

What should one, therefore, do at the Secondary Education level since in reality we have to work with classes made up of students coming from entirely different backgrounds as regards motor, affective and cognitive aspects?

As educators of different backgrounds went through a period of discussions comparable to ours, they have found working with the concept of Physical Aptitude and Health to be an educational and feasible alternative for their classes.

A strand of thought emerges that deepens its roots along these lines: Physical Education classes that are aware of today´s problems cannot fail to choose education for health as one of its key purposes. If Physical Education is to be instrumental in providing for the social education of students and contributing for a productive, creative and successful life, education for health will prove to be a means through which it can materialize its purposes.

School life has been considerably changed by the new Law, as it gives schools and their pedagogical team the leeway to undertake initiatives of their own. Physical Education teachers are now on greater demand as regards their professional qualification and the use of their knowledge, especially with respect to the planning of activities that will prove instrumental in meeting students' interests and needs.

Any project aimed at encouraging physical activity, therefore, should be proposed by the teacher him or herself, submitted to the pedagogical team for approval and then included in the school's proposed work plan.

The School Bylaws are the "table of commandments" within the school, which may, as allowed under the Law, expand the number of work hours allotted to a given curriculum component, include it in the class hours or emphasize it as a priority, or simply reduce it, should no action be implemented.

It is incumbent on Physical Education teachers to recover the prestige lost over the past decades by proposing and developing projects that will indeed accomplish the objectives set for Secondary Education.

Technological progress has brought about changes in human habits with both positive and negative results. The negative results include, mainly, the stress buildup, which makes people subject to psychosomatic diseases, such as anxiety, frustration and depression or even a widespread feeling of dissatisfaction, which has proved detrimental to interpersonal relations. Other factors often quoted as resulting from technological progress include respiratory and muscle problems, immune system disorders, high blood pressure, arteriosclerosis and heart diseases.

Because Secondary Education students are exposed to some of these circumstances, including school programs that enhance learning and attach value to physical exercises that increase and sustain heart frequency at submaximum levels, stretching and body flexibility, relaxation and compensation with a prophylactic purpose will accordingly result in better quality of living.

Physical Education teachers must endeavor to integrate their work with that developed at the school level by positioning their curricular components at the same level of professionalism and commitment to students' full development. Therefore, we can demonstrate our professional competencies not only by organizing school championships but also by providing guidance to students participating in the school's Science Fair, by sharing concepts acquired through classes, panel exhibits and posters, and even by holding specific events, such as, the health week, recreational Saturdays, sports tournaments involving the community, and so forth.

Since the body is at the same time a means and mode whereby people become part of their surrounding reality, i.e., the world, it is necessarily filled with meaning. We have always known that postures, attitudes, gestures and above all one's look express people's trends, emotions and feelings in a given situation and context better than words.

Body communication between and among individuals tends to occur when they are aware of their sensitive bodies, characterized by will and intentionality. Therefore, the reception and conveyance of information through body movements among individuals occur naturally and spontaneously, and a link of sensitivity is thereby established between/among them. Communication is about negotiating meaning among people, it is a creative act. And when we communicate we form a harmoniously integrated system of interaction and reaction.

Gestures, postures and facial expressions are created, sustained or changed because man is a social being and lives in a given cultural context. This means that individuals use different forms of body communication that change from culture to culture.

Furthermore, individuals in turn learn to use body expressions according to the environment in which they developed as a person. This is equivalent to saying that every body movement has a meaning, according to the context. The "right" or "wrong" body movements are determined socially, and society indicates the proper behavior. The establishment of cultural standards of body movement occurs as if it were a natural phenomenon. The way one walks, one's body posture and gestures, the way one looks and listens, the body´s motor conduct comes as a purely biological fact. Understanding a given phenomenon depends on the signifying tools available. Such tools will shape the individual's internal and external actions and will therefore influence interpersonal relationships.

Any field of knowledge that sets out to study human movements or somehow use them should approach them in all their complexity. In the first place, one should take into account the body and social community/meio social relation; this is where we will find habits such as friendly kisses and hugs, soccer games, children's games and tricks or motor codes used by a given community.

Body language — developed not only through Physical Education but also through Art — brings together and exposes a myriad of possibilities, which the school, in turn, encourages and consolidates.

Accordingly, what is expected from Secondary Education students is a broad understanding of and exercise in body culture and its expressions.

Projects such as game development, revisiting popular, folk games or recreational traditions, story telling and the creation of choreographies can be perfectly and closely in line with Portuguese, History, Geography, Sociology, etc. It should be noted that the path for integration is not the one-way but rather the two-way avenue; which means that the

other fields of knowledge must use body movement and likewise pursue an efficient integration with Physical Education.

- **Competencies and skills to be developed in Physical Education**

**Representation and Communication**

- Showing autonomy in conducting physical exercises, as well as the ability to discuss and change rules, bringing together elements of different forms of movement and better using the knowledge acquired on body culture.
- Taking an active stance as regards the practice of physical activities, and being conscious of their importance in one's life as a citizen.
- Participating in activities in large and small groups, understanding individual differences and seeking to cooperate so that the group can reach its proposed objectives.
- Recognizing that peacefully shared experiences and practices are effective means of collective growth, by engaging in dialogue, critical thinking and adopting a democratic stance about different viewpoints under discussion.
- Taking an interest in new, multiple variations of Physical Education as a research topic, as well as a field of social interest and a promising labor market.

**Research and comprehension**

- Understanding how the human body works so as to recognize and change physical activities, appreciating their value as a source of improvement in one's physical aptitude.
- Developing conceptually grounded notions of effort, intensity and frequency, and applying them to one's physical activities.
- Reflecting about the specific body culture information, being able to discern it and reinterpret it on scientific basis, and adopting an autonomous stance in choosing activities and procedures aimed at sustaining or developing a healthy status.

**Social and Cultural Contextualization**

- Understanding the different forms and expressions of body culture, recognizing and appreciating differences in performance, language and expression.

## 6. Knowledge of Art

Knowing Art at the Secondary Education level means that students acquire cultural and esthetic knowledge as part of practices in artistic production and appreciation that is

essential for students to develop and perform socially as citizens. At the Secondary Education school, continuing to promote the cultural and esthetic development of students with quality within the sphere of Basic Education may help them develop an interest in new possibilities of learning, acting and working with Art throughout their lives.

The guidelines set forth herein are aimed at contributing to strengthening students' sensitive and inventive experience, as well as to an exercise in citizenship and ethics that will prove conducive to the development of artistic identities. Such strengthening results from the continuity provided to the knowledge of art developed in early and elementary education in **music, visual arts, dance** and **drama**, thus expanding artistic knowledge into other form of expression, such as **audiovisual arts**.

Though non-continuous and short of satisfactory as regards artistic specificity, there have been some attempts at improving art education at Brazilian Secondary Education schools in the past decades of the 20th century. Despite these initiatives, from 1971 onwards, when Law 5,692 (which reformed Elementary and Secondary Education in Brazil) was in effect, Art began to be addressed as an experience of sensitivity and as generic knowledge. However, and paradoxically, it was no longer valued as human and historic knowledge that is important in school education. At the school level, Art began to be viewed as a mere proposal for artistic activity, often unrelated to any collective school education project, and teachers were expected to work with all artistic languages (including those for which they had not been formally trained) with a sense of multiple-purpose practice, without due attention to professional training and enhancement.

This situation prevailed throughout the 80's and 90's, so much so that many Brazilian Secondary Education schools have had a very limited or non-existent experience in the teaching and learning of music, visual arts, plastic arts, dance, drama; in sum, knowledge of Art *per se*.

As part of the field of Languages, Codes and related Technologies in Secondary Education, Art is particularly considered for its esthetic and communicative dimensions. Because it is a human knowledge that is expressed at the sensitive-cognitive level, through Art we express meanings, sensitivities, forms of creation and communication about the world of nature and culture. This has been so throughout the history of humankind.

One of the specificities of artistic knowledge lies in the fact that in art productions, ideas are developed in a sensitive, imaginative and esthetic fashion by its producers or artists. In many respects, this synesthetic set of ideas appears in the art product while it is being developed and after it is ready as it is conveyed to and enjoyed by other people. This

knowledge, this wisdom and know-how involved in presenting esthetic sensitivities and ideas in a work of art is learned by an art producer through his interpersonal, intergroup relationships and as a result of the social and cultural diversity in which he/she lives. Emotions and thoughts that are developed, summed up and expressed by people who produce Art and which are materialized in art products themselves, and in turn mobilize the sensitivity and cognition of their audiences (viewers, admirers, audiences in general), who are, therefore, involved in the production of Art and in its history. It is in social and cultural relationships — including those experienced in school education — that we practice and learn these forms of knowledge.

By means of esthetic practices involved in artistic production and enjoyment and appreciation, and through reflections about same practices in the Art classes, students are able to develop forms of knowledge that will lead them to understand and become involved in esthetic decisions, thus gaining cultural and contextualized knowledge about Art, how to communicate it, and its codes. In the Art classes, there are several different ways of learning about the esthetic elements found in art products such as music, visual arts, dance, drama, audiovisual arts, and about the possibilities of enjoying these art products in the different languages.

For that reason, it is essential that in the Art course students be able to continuously extend their practical and theoretical knowledge of Art, as learned in previous levels of basic schooling and in their everyday life. They will thus be broadening their knowledge about the production, appreciation and enjoyment and History of Art, as expressed in music, visual arts, dance, drama, as well as audiovisual arts. They may even include art practices in their several different interfaces, interconnections and uses of new communication and information technologies.

It is by developing students' esthetic and artistic knowledge that the Art course stands as a partner of those courses focused on in the field of Languages, Codes and Related Technologies and in the other fields of knowledge that make up Secondary Education. By participating in practices and theories of artistic languages in the dynamics of Languages, Codes and Related Technologies, the Art course should cooperate for the development of interconnected educational projects in a significant manner, by linking its contents with cultural knowledge acquired by students in Information Technology (Cyberculture), Physical Education (Body Culture and Movement), Portuguese and Foreign Languages (Verbal Culture, including literary arts).

In sum, we believe that artistic and esthetic practices in music, visual arts, dance, drama and audiovisual arts not only enable links with other languages in the field of Languages, Codes and Related Technologies but also can prove instrumental in developing young people's identity and a new citizenship for those who benefit from Secondary Education,

thus fostering an awareness of a multicultural society and bringing students into contact with the cultural values, beliefs and competencies of the world of which they are part.

- **Competencies and skills to be developed in Art**

**Representation and communication**

- Carrying out individual and/or collective artistic productions in the different art languages (music, visual arts, dance, drama, audiovisual arts).
- Appreciating the value of art products in their several different languages, and developing the ability not only to enjoy but also to esthetically assess Art.

**Research and comprehension**

- Analyzing, reflecting on and understanding the different art-related processes, their different material and abstract tools of social, cultural and historic expressions.
- Knowing, analyzing, reflecting on and understanding culturally built criteria that are based on similar forms of knowledge, of a philosophical, historical, sociological, anthropological, semiotic, scientific and technological nature, among others.

**Social and Cultural Contextualization**

- Analyzing, reflecting on, respecting and preserving different expressions of Art — in its multiple functions — used by different social and ethnic groups, interacting with the national and international art heritage, which one is expected to know and understand in its social and historic dimension.

## 7. Knowledge of Information Technology

The purpose of including Information Technology as a curriculum component in the field of Languages, Codes and Related Technologies is to allow access by all students willing to make it an element of their culture, as well as by those for whom a purely technical approach seems insufficient for them to understand its deeper mechanisms. As the most recent of all languages, it does not replace the others; on the contrary, it complements them and serves as a technological framework for the several different forms of traditional communication.

Should schools incorporate Information Technology as a component in the teaching-learning process or should they only train students to instrumentally use the machines? The arrival of computers at schools must be preceded by a discussion on the paradigms and processes currently in place. The issue became a source of concern for education professionals in the first half of the 1990s, following the initial hype. At that point in time, the Internet emerged on the scene. The lack of a specific planning for full utilization of this resource in education and the absence of teacher-oriented training have impaired the effective use of the Internet.

The new LDB Law opens prospects for an actual debate about Information Technology in Secondary Education. What do we want to teach? Whom do we want to teach? What kind of students has the aptitude to become an IT professional, as opposed to those interested in just being good users? What is the optimum profile of the teachers who will use this knowledge in their courses in the several different realities that currently coexist in our country? Information Technology is more than just a room filled with PCs; it is a reality that surrounds us in virtually all environments, regardless of the region of the country one is in.

In education, changes do not take place as fast as is the case in technology, which creates a gap to be bridged. The world of technology and information provides us with hints, it improves our senses, it allows us to enjoy a better standard of living, one which our forefathers did not even dream of. To have or not to have access to information may become an element of discrimination in the new knowledge society now being formed. What already can be observed is that there is an increasing gap between those who know and those who do not know how computers work.

This problem can be overcome by implementing changes in school curricula, which should develop the competencies required for students to have access to and use information via computers, and build students' awareness as to the pervasive presence of new technologies in everyday life.

As a revolution takes place in life and in the world of labor through automation processes, schools must respond not only by changing contents but also by accepting new elements that make it possible for students to be an fully integrated part of the world they live in.

The huge quantity and variety of information currently available requires that people develop the ability to select it, considering what their objectives are, which means developing the ability to analyze, establish relationships, sum up and assess information.

It is incumbent on schools, acting in partnership with the marketplace, the State and society to turn young people into more versatile citizens and workers who can easily adapt to the fast changes that technology has brought about in modern life. Ongoing, permanent education will be one way to foster the continuous improvement and adaptations that are required from the new professional alternatives.

In sum, information technology is currently found in our everyday life, and including it as a curricular component in the field of Languages, Codes and Related Technologies means preparing students for the technological and scientific world, thus bringing the school closer to the real, contextualized world.

Students must not be seen merely as users of information technology as a learning tool but also as users who are familiar with the equipment and devices, software applications and concepts that will enable them to properly position themselves in the labor market and develop both personally and interpersonally.

- **Competencies and skills to be developed in Information Technology**

**Representation and communication**

- By means of practical experiences, to develop prototypes of automated systems in different fields, linked to reality, by using interdisciplinary knowledge to that effect.
- Recognizing Information Technology as a tool conducive to new learning strategies, capable of significantly contributing to the knowledge development process in different fields of knowledge.

**Research and comprehension**

- Identifying the key pieces of equipment in Information Technology, recognizing them according to their features, functions and models.
- Understanding the basic functions performed by the main automation products in Information Technology, such as operating systems, graphical interfaces, word processors, calculation spreadsheets and presentation software applications.

**Social and cultural contextualization**

- Being familiar with the concept of network, distinguishing the global ones - such as the Internet, aimed at encouraging research thanks to digital technologies and making it possible for people to gain knowledge as other realities, experiences and cultures - from local or corporate networks, such as the Intranets, aimed at fast tracking actions related to professional activity, with an emphasis on teamwork.
- Understanding computer-related concepts that facilitate the introduction of specific tools into one's professional activity.
- Recognizing the role played by Information Technology in the organization of social and cultural life and in people´s comprehension of reality, linking the use of computers to real experiences, be it in the world of labor, be it in people´s private life.

## 8. Prospects and Challenges

The option for a task in this field seeks to take into account the overlapping among the different languages, given the fact that, by definition, they express cultural and social meanings and perform a communicative function.

Portuguese, Foreign Languages, Art, Physical Education and Information Technology courses potentially share field-specific features that would suggest a closely coordinated approach to communicative processes.

Speech, the written language, body movements and Art are closely linked to cognition, perception, and action and, as such, they are expressions of culture. All these systems seek to make meanings susceptible of communication. Languages diverge at the expression level, and constitute their own forms of expression, and again converge at the content level, the backdrop for the human construction of symbols.

The objective study of symbols at the school setting can allow students to understand their world vision as well as that of others; arbitrary classifications as regards doing, seeing, believing, thinking, feeling and acting that are all expressed in the form of language.

One's mother tongue plays the role of making comprehension possible and a point of convergence for the discourses used in different spheres of social life. It is with and through one's mother tongue that the arbitrary social forms of world vision and division are used as knowledge and communication tools.

Through one's mother tongue one learns an "immediate sense of the world", which is to be disclosed in the course of a process of recovering this and other possible senses; the identities and diversities that intersect one another in different discourses.

Linguistic relationships mark the symbolic power accumulated by their protagonists. There is no such a thing as an abstract linguistic competence but rather a linguistic competence that is constrained by the production/ interpretation conditions of utterances and forms of uttering, as well as by the contexts in which language is used. The code it uses performs a role that is both communicative and regulatory in nature.

Mastering only part of the code does not result in successful communication. Certain situations of spoken or written language communications may even produce absolute silence in one who is ill at ease in a given dialogue.

From this perspective, the development of the linguistic competence of Secondary Education students is not based solely on the technical mastery of language as legitimized by a social

norm but rather, and mainly, on the competence of knowing how to use the language in subjective and/or objective situations that require different degrees of abstraction and reflection about the contexts and the status of the speakers involved — the communicative competence as seen from the standpoint of the social and symbolic value of language.

The foreign language, given its distance vis-à-vis another language, adds to the comprehension of the possibilities of world visions and allows students to have access to information and international communication that is necessary for their full development as individuals in modern society.

The modes of appreciation and production of art objects are part of this field inasmuch as they recover conventional forms of building the collective imaginary and the culturally representative heritage, as preserved in the course of time and in space and as expressed in languages that have their own rules and codes, such as music, painting, dance etc., including Literature.

Mathematical language, taken as a language that organizes a world vision, must be highlighted with an emphasis on the contextualization of its logical patterns, its social value and sociability; as such, it is to be understood in the light of the intersections that make it comparable to verbal language.

The analysis of other languages, such as the language of television, cinema, radio and, the most recent of all, Information Technology, may point towards an increasingly comprehensive convergence between communicative processes and language systems.

Physical Education, as taught through games developed in social life with specific body patterns aimed at making for a harmonious living together expands students´ knowledge of the body and the possibility of better understanding social rules.

The uses of the different languages and their codes are only possible through practice, even if under school simulation conditions. Knowledge calls for more than a mere reproduction of values. It is about the sense of the symbolic effectiveness mediated by language, knowledge of the interconnected network of intertwined and constantly changing texts.

Teachers perform an essential role in this proposed practice. Teachers are the ones who take the initiative of making choices and, by analyzing students' needs, they may plan to develop, deepen and interrelate previously acquired knowledge contents.

The analysis of knowledge contents, students' needs and their relevant social circumstances provide us with the basic elements for pedagogical intervention, curriculum organization, choice of methodology, teaching material and forms of assessment.

Without being mandatory, this paper seeks to point out a direction and it is our understanding that the existence of diversity does not do away with the objective of developing shared, common knowledge contents.

Organizing the curriculum by fields of knowledge, as proposed, means accepting the transdisciplinary nature of language and the interrelationship among the language systems, without losing sight of the specific features of key concepts pertaining to the different courses and their respective research methodologies. Further, the proposal is aimed at bringing about a horizontal and vertical integration of knowledge contents worked on by schools, similarly to those found in life in society. It is not an easy task, as it requires that people be open to discussion and criticism.

Teachers cease to be "islands" as they interact with their colleagues in the pursuit of a collective, shared project. In that sense, the proposal is not a novel one. The novelty element lies in its actual updating at the school level, which requires knowledge, participation, availability, professional interest and an understanding of the social role played by the school.

It further requires, obviously enough, the support from the educational systems in reviewing the school workday, in allocating classes and expanding the number of hours devoted to joint work, involving the coordination of people who may be able to assist teachers in preparing their collective projects.

It has been our purpose to herein reflect about the role played by the field of Languages, Codes and Related Technologies in the Secondary Education curriculum, assessing the transdisciplinary nature of languages, and the way they interact and are found in all other knowledge contents addressed by schools. As such, they are part of every individual and part of the organized society as a whole; and it is in the symbolic world of language that struggles for participation, creation and social transformation are waged.

The definition of principles marks an initial moment in time that is required for updating schools´ pedagogical projects, ultimately aimed at developing social, cognitive, motor, affective and intersubjective competencies.

The pedagogical intervention aims at deepening the knowledge contents that are viewed as typically school-related and those derived from life in society, thus expanding students' spheres of action.

**Chapter III**

**Natural Sciences, Mathematics and Related Technologies**

## 1. Introduction

The learning of Natural Sciences, which is qualitatively different from learning in Elementary Education, should contemplate forms of appropriation and construction of thought systems that are more abstract and resignified, so as treat them as a cumulative process of gaining knowledge and breaking away with consensus and methodological assumptions. The purpose of this field of knowledge consists in learning up-to-date scientific conceptions regarding the physical and natural world as well as the development of work strategies focused on problem solving, with a view to bringing students closer to scientific and technological research work, as institutionalized activities aimed at producing knowledge, goods and services.

Studies in this field should take into consideration the fact that Mathematics is a language that seeks to account for aspects of the real world and that, as such, it serves as a formal expression and communication tool in different sciences. It is important to take into account the fact that sciences, just as their related technologies, are historically situated human constructions and that the objects of study they focus on and the discourses accordingly developed do not mix or overlap with the physical and natural world, although the latter is referred to in these discourses. It is also important to understand that, notwithstanding the fact that the world is the same, the objects of study are different as knowledge constructs produced by sciences through their own laws, which must be appropriated by and situated in the internal grammar of each science. Moreover, it is important to understand the scientific principles built into the technologies, to associate them to problems that one intends to solve and solve problems in a contextualized manner by applying those scientific principles to real or simulated situations.

In sum, learning in the field of Natural Sciences, Mathematics and Related Technologies underscores the understanding and application of scientific knowledge contents to explain the workings of the world as well as to plan, carry out and assess interventions upon reality.

## 2. The Meaning of Field-Specific Learning

Law LDB/96, by defining Secondary Education as the last and complementary stage of Basic Education, and Resolution CNE/98, issued by the National Council on education, by establishing the National Curriculum Guidelines for Secondary Education, which organize the fields of knowledge and gear education towards the production of values such as sensitivity and solidarity as attributes of citizenship, point out the way in which the learning of Sciences and Mathematics [previously started in Elementary Education] should be complemented and consolidated in Secondary Education. In this new stage, one in which it is already possible to rely on greater student maturity, the education objectives now begin to have more of a developmental ambition as regards not only the nature of information dealt with, the procedures and attitudes involved, but also the skills, competencies and values being developed.

More broadly integrated in the community´s life, Secondary Education students are now in a position to understand and develop a fuller awareness of their responsibilities and rights, together with discipline-specific learning.

At the Secondary Education level, these objectives involve, on the one hand, the consolidation of discipline-specific knowledge in Biology, Physics, Chemistry and Mathematics, including the scientific procedures pertaining to their specific study objects, development goals and pedagogical treatments. On the other hand, they also involve the interdisciplinary coordination of knowledge, made possible by several different circumstances, especially technological and practical contents, already found within each discipline but more particularly appropriate to be dealt with from an integrating perspective.

It should be noted that the interdisciplinarity of scientific and mathematical learning does not dissolve or do away with the indisputable disciplinarity of knowledge of knowledge. The degree of specificity actually found in the different sciences, and partly also in the related technologies, only with difficulty would be learned in Elementary Education, and its contents are naturally reserved for Secondary Education. Furthermore, discipline-based scientific knowledge is such an essential part of contemporary culture that its presence in Basic Education and hence in Secondary Education is indisputable. These are, essentially, the most distinctive features of Secondary Education that are germane to curriculum organization.

The objectives of Secondary Education in each field of knowledge should jointly involve the development of practical and contextualized knowledge that is in line with the needs of contemporary life, and the development of broader and more abstract knowledge, in tune with general culture and a world vision. For the field of Natural Sciences, Mathematics and Related Technologies, this is particularly true as the increasing appreciation of the value of

knowledge and the ability to innovate calls for citizens capable of learning continuously, for which it is essential that they have a general background training, rather than just specific training.

By terming this field of knowledge as not only Sciences and Mathematics but also their Related Technologies, it is clearly indicated that, in each of its disciplines, the intention is to foster competencies and skills that will prove instrumental in practical interventions and judgements. This means, for instance, being able to understand equipment and technical procedures, to obtain and analyze information, and assess the risks and benefits involved in technological processes, all of which are highly significant for the exercise of citizenship as well as for one's professional life.

With this understanding in mind, the learning process should not only contribute to foster technical knowledge but also prove conducive to a broader culture, by developing the means with which to interpret natural events, understand procedures and equipment used in everyday social and professional life, as well as to convey a vision of the natural and social world. It should provide for the construction of a dynamic understanding of our material experience; a harmonious coexistence with the world of information; a historic understanding of social and productive life; an evolutionary perception of life, the planet and the cosmos; in sum, a learning process of a practical and critical nature and marked by an active involvement with scientific culture, an essential ingredient in human adventure.

Such an ambitious view of scientific and technological learning in Secondary Education, unlike the one currently in place in most schools, is not a utopia and can actually be put into practice in the teaching of Biology, Physics, Chemistry and Mathematics, together with the technologies related to these sciences. Nonetheless, every school and its community - and not just the teacher and the school system - need to be mobilized and involved to create the new work conditions and thus foster the intended educational transformation.

Carrying out a learning process with these development ambitions, more than just accumulated scientific and pedagogical knowledge in each discipline, depends on the overall practices as well as on the new guidelines established at the school level. In other words, it depends on a broadly shared understanding of the meaning of the educational process. The learning process on the part of students and teachers and its continuous improvement should be the result of a collective effort, in a space for dialogue made possible by the school and facilitated by the school system with an active involvement of the community.

In the summary below, a list of the main development-oriented objectives can be found. It is not simply a matter of better classifying the target competencies and skills, but rather, and above all, it is a matter of highlighting the convergence of the development training efforts of the three fields of knowledge, also underscoring the possibilities to establish links

and coordinate them with the overall educational objectives of Secondary Education. Thus, the competencies and skills found in the summary below, which attach a shared purpose to the teaching of the different courses in the field of *Natural Sciences, Mathematics and Related Technologies*, may provide guidance to the integrated work of teachers in this field and likewise prepare the groundwork for a closer coordination of their efforts with those by teachers of different fields of knowledge, thus consolidating the educational program or the pedagogical project, itself the result of converging actions aimed at students´ development.

- **Field-Specific Competencies and Skills**

**Representation and communication**

- Developing the ability to communicate.
- Reading and interpreting texts of scientific and technological interest.
- Interpreting and using different forms of representation (tables, charts, expressions, icons, etc.).
- Being able to articulate properly and clearly, using the correct terminology.
- Producing texts suitable to prepare reports on experiences, express doubts or present conclusions.
- Using basic drafting and information technologies, such as computers.
- Identifying relevant variables and selecting the procedures required to produce, analyze and interpret the outcome of scientific and technological processes and experiments.
- Identifying, representing and using knowledge of geometry to improve reading skills, comprehension and the ability to act upon reality.
- Identifying, analyzing and applying knowledge about the value of variables, as represented in charts, diagrams or algebra expressions, for testing trends, extrapolations and interpolations, as well as interpretations.
- Qualitatively analyzing quantitative data represented in charts or algebra formulations and as related to social, economic, scientific or daily contexts.

**Research and comprehension**

- Developing the ability to call natural and technological processes into question, identifying regular patterns, making interpretations and predicting evolution patterns.
- Developing the ability to reason and learn.
- Raising questions on the basis of actual situations and being able to understand those previously described.
- Developing explanatory models for technological and natural systems.
- Using measurement and calculation tools.

- Looking up and systematizing information that is relevant for the comprehension of a problem situation.
- Developing hypothesis and anticipating results.
- Developing strategies to overcome issues.
- Interpreting and criticizing the outcome of experiments and demonstrations.
- Correlating scientific and technological knowledge in an interdisciplinary approach.
- Understanding and applying specific methods and procedures used in Natural Sciences.
- Understanding the randomical and non-deterministic nature of natural and social phenomena, and being able to use tools suitable to measure, determine samples and calculate probabilities.
- Using knowledge of Physics, Chemistry and Biology to explain the natural world and to plan, carry out and assess practical interventions.
- Applying technologies related to Natural Sciences in the school setting, in the workplace and in other relevant contexts in students´ life.

**Social and cultural contextualization**

- Understanding and using science as an element with which to interpret and intervene upon reality, and technology as systematic knowledge of a practical nature.
- Using scientific and technological elements and knowledge to diagnose and solve social and environmental issues.
- Associating scientific knowledge and methods with technologies used in the production system and services.
- Acknowledging the historic sense of science and technology, understanding their role in human life in different points in time and their effect on humankind´s ability to transform the environment.
- Understanding sciences as human constructions, as well as how they have developed through a process of accumulation, continuity or shift in paradigms, by correlating scientific development with social transformation.
- Understanding the relationship between development in Natural Sciences and technological development and being able to relate different technologies to the problems to be solved.
- Understanding the impact of the technologies related to Natural Sciences in one's personal life, in the production processes, in the development of knowledge and in people's social life.

**3. Knowledge of Biology**

Each specific science has an intrinsic code, an inner logic, its own research methods, which are expressed in the form of theories and models built to interpret the phenomena that one intends to explain. Appropriating these codes, concepts and the related methods found in each of the sciences and understanding the relationship between science, technology and society means expanding the possibilities to comprehend and actually participate in the world.

Biology studies the phenomenon of life in all of its diversity. This phenomenon is characterized by a number of organized and integrated processes, at the cell level, at the individual's level or even at the level of organisms and their environment. A living system is always the result of interaction between its building elements and the interaction between same systems and the other components of its habitat. The different forms of life are subject to transformations, which occur in time and in space and likewise lead to transformations in the environment.

In the course of the history of humankind there have been several different explanations for the emergence and diversity of life, so scientific models have lived side by side with other explanatory systems, such as, for instance, those of a philosophical or religious inspiration. The learning of Biology should allow a comprehension of the living nature and the limitations of different explanatory systems, a contrasting of same systems and an understanding of the fact that science does not have definitive answers for everything, one of its characteristics being the very possibility of being called into question and changed. It should also allow an understanding of the fact that scientific models serve the purpose of explaining not only what we can observe directly but also what we can only infer; the fact that such models are the product of the human mind and not nature itself; human constructions that always seek to keep the observed reality as the legitimacy criterion.

Elements of the history and philosophy of Biology make it possible for students to understand that there is a broad network of relationships between scientific production and the social, economic and political reality. It is possible to notice that the formulation, the success or failure of different scientific theories are associated with their moment in history.

Students´ knowledge of Biology should feed into their judgement of controversial issues pertaining to the development, the utilization of natural resources as well as the use of technologies involving intensive human intervention on the environment, the assessment of which must take into account the dynamics of ecosystems, organisms, in sum, the way nature behaves and life is processed.

The decision as to what and how to teach Biology at the Secondary Education level should not take the form of a list of topics to the detriment of some other list, whether by tradition or arbitrary innovation, but rather the decision should be made in such a way as to further,

as far as Biology is concerned, the educational objectives established under Resolution CNE/98 issued by the National Council on Education for the field of Natural Sciences, Mathematics and Related Technologies and partly described in the general sections of this document. Among these objectives, there are aspects of Biology that have to do with the construction of a world vision, others of a more practical and instrumental nature and, as such, geared towards action, as well as those that ensure the development of concepts, assessments and a citizenship-oriented attitude.

A key issue for the construction of a world vision is the perception by students of the dynamic complexity of life, an understanding of the fact that life is the result of the constant and simultaneous interactions among many elements, as well as the fact that theories in Biology and in other sciences are explanatory models developed in certain social and cultural contexts. This stance seeks to overcome the ahistoric vision that many textbooks have disseminated, a vision in which life is said to be established as the mechanical coordination of parts, and as if, in order to comprehend it, it would suffice to memorize the name and function of such parts, as if life boiled down to a mechanicist biological game.

In the course of Secondary Education, in order to ensure a comprehension of the whole, it is more suitable to work from a general viewpoint in which the phenomenon of life is a totality in itself. The environment, which is the outcome of the interactions between abiotic factors and living beings, may be presented on a second level and it is on the basis of such interaction that it is possible to know each organism in particular and recognize it in the environment, and not vice-versa. It will then become even more significant to know that each organism, in turn, is the result of interactions among organs and systems which, individually, are formed by a set of interacting cells. And, at the innermost level, each cell is made up of interactions among its organelles, which also have their own individual and particular features, as well as the interactions between this cell and other cells.

At the Secondary Educational level it is not possible to deal with all biological knowledge or all technological knowledge related to it. It is more important to treat these knowledge contents in a contextualized manner, by showing how, why and when they were produced and presenting the history of Biology as a non-linear and often contradictory movement.

More than just providing information, it is essential that the teaching of Biology be geared towards the development of competencies that will allow students to deal with information, comprehend it, elaborate on it, and refute it when appropriate; in sum, comprehend the world and act upon it, using the knowledge contents acquired in Biology and technology.

The development of such competencies starts at Elementary School but is not confined to it. Each of these schooling levels has its own characteristics, each level representing specific moments in student's life and development, but they all have in common the fact that they

involve people and develop abilities and potentialities that will allow them to fully exercise their citizenship in these same moments in life.

It is therefore necessary to select contents and choose methodologies that are consistent with our educational purposes.

In sum, in the teaching of Biology it is essential to develop attitudes and values that are germane to the relationships among human beings, between human beings and the environment, between human beings and knowledge, thus contributing for an education that will develop and train sensitive and supportive individuals as well as citizens who are aware of the processes and regularities of the world and of life; individuals and citizens who are able to carry out practical actions, form judgements and make decisions.

- **Competencies and skills to be developed in Biology**

**Representation and communication**

- Describing processes and characteristics of the environment or living beings, as observed through the microscope or by the naked eye.
- Being able to perceive and use the codes that are inherent and specific to Biology.
- Raising assumptions and hypothesis about the biological phenomena being studied.
- Presenting the biological knowledge learned in an organized fashion, through texts, drawings, schematics, charts, tables, mock-ups, etc.
- Understanding different forms of access to information (observation, experimentation, text reading, image reading, interview), selecting those forms that are relevant to the biological topic under study.
- Expressing doubts, ideas and conclusions about biological phenomena.

**Research and comprehension**

- Correlating phenomena, events, processes and ideas in Biology; developing concepts, identifying regular patterns and differences, developing generalizations.
- Being able to use scientific criteria to classify animals, plants etc.
- Correlating different conceptual contents in Biology (internal logic) to comprehend phenomena.
- Being able to establish relationships between the part(s) and the whole of a biological phenomenon or process.
- Selecting and using scientific methodologies that are suitable to solve problems, using, when appropriate, statistical treatment in the analysis of the data collected.

- Raising questions, developing diagnoses and proposing solutions to problems raised by using elements of Biology.
- Using biological notions and concepts in new learning situations (existential or school-based).
- Coordinating the knowledge contents of different disciplines to understand biological events or processes (external logic).

**Social and cultural contextualization**

- Recognizing Biology as human know-how and, therefore, as a historically determined science, the result of a convergence of social, political, economic, cultural, religious and technological factors.
- Identifying the interference of mystical and cultural aspects in common sense knowledge related to biological issues.
- Acknowledging human beings as players who drive deliberate transformations in their environment and are at the same time subject to the consequences theerof.
- Assessing intervention actions, identifying those aimed at preserving and implementing individual, collective and environmental health.
- Identifying relationships between scientific knowledge and technological development, considering the preservation of life, the conditions of living and sustainable development concepts.

## 4. Knowledge of Physics

The knowledge of Physics incorporated into culture as a technological tool has become essential to the development of contemporary citizenship. It is expected that the teaching of Physics at the Secondary educational level will contribute to develop an effective scientific culture that will, in turn, allow individuals to interpret natural events, phenomena and processes, thus situating and scoping the interaction between human beings and nature as part of a constantly changing Nature. To that end, it is essential that the knowledge of Physics be expressed as a historic process, the subject of continuous transformation and associated to other forms of human expression and production. It is also necessary that the Physics culture include an understanding of the overall set of equipment and procedures, both technical and technological, of everyday domestic, social and professional life.

By providing these knowledge contents, the learning process in Physics furthers a close coordination of an entire world vision, a dynamic comprehension of the universe that is broader than our immediate material surroundings and therefore capable of transcending our time and space limits. Thus, along more practical lines, Physics also reveals a

philosophical dimension whose beauty and importance should not be underestimated in the educational process. In order for these objectives to become guidelines for the organization of the teaching of Physics in Secondary Education, it is essential to translate them in terms of competencies and skills and go beyond traditional practice.

The teaching of Physics has often been conducted by presenting concepts, laws and formulae in a non-coordinated fashion, as if in isolation from the world in which students and teachers live and, for this and other reasons, it has often been devoid of meaning. Traditional teaching has attached priority to theory and abstraction from the very beginning, to the detriment of a gradual development of abstraction that is at least grounded on practice and concrete examples. It has emphasized the use of formulae in artificial situations, thus separating the mathematical language that these formulae represent from their actual meaning in Physics. It has insisted on the repetitive problem-solving exercises, assuming that learning occurs by automation or memorization, as opposed to the construction of knowledge through acquired competencies. It presents knowledge as if it were a finished product, the result of the brilliant mind of geniuses such as Galileo, Newton or Einstein, thus leading students to conclude that there remain no more significant problems to be solved. Furthermore, it involves a list of overly extensive contents that precludes the necessary deepening of knowledge and the establishment of a constructive dialogue.

This situation does not stem solely from lack of proper teacher preparation or from the constraints imposed by deficiencies in school conditions. On the contrary, it reflects a structural distortion that has been gradually assimilated by the participants in the school system and one that has been taken to be as a natural fact. Inasmuch as it was intended to be of a preparatory or technical nature in a not-so-distant past, Secondary Education had other purposes and was consistent with the then current requirements. "Back then" teaching "worked well" because it was preparatory in nature. The emphasis was placed on the "development of reasoning" in an isolated fashion, and a deeper comprehension of things was postponed to further levels of teaching or to a non-existent future.

It is necessary to rethink what kind of Physics should be taught in order to allow a better understanding of the world and to prepare students for a more appropriate exercise of citizenship. We all know that, to that end, there are no simple or single solutions nor ready-made prescriptions that ensure success. It is a matter to be faced by educators of every school, of every social reality, with a view to living up to the wishes and expectations of all of those who participate in the educational process, brought together through a clear-cut pedagogical proposal. It is always possible, nevertheless, to highlight those aspects that lead the teaching process to unfold in the desired direction.

Therefore, it is not a matter of drafting new lists of contents and topics but, above all, a matter of attaching new dimensions to the teaching of Physics. This means fostering contextualized knowledge that is incorporated into the life of every youth.

As Secondary Education is a specific moment in the cognitive development of young people, the learning of Physics has specific features that may prove instrumental in building an interpretation that is rich in abstractions and generalizations, both in a practical and conceptual sense. Considering the time of major changes we are currently going through, fostering students' autonomy to learn should be a central concern, as the knowledge content of future professions may still be in the process of being established, meaning we should pursue those competencies that ensure students´ independence to act and learn in the future.

But skills and competencies are materialized in actions, objects, subject matters, experiences involving a certain perspective on reality, which we term Physics and which may be developed under different topics, take on different forms in each case and become more or less suitable depending on the context in which they are developed. Form and content are thus deeply interdependent and ultimately contingent on the topics to be focused on.

The set of topics chosen for the study of Physics in the Secondary Education curriculum does not have to be taken as a set of prescriptions nor as a complete or exhaustive listing. Rather, it should seek to make plain, through different ways, that, more than just a mere reformulation of contents or topics, the intended purpose is to foster a shift in emphasis to meet both present and future needs of Secondary Education youngsters´ in their individual, social and professional life. The desired skills and competencies are summarized below.

- **Competencies and skills to be developed in Physics**

**Representation and communication**

- Understanding statements involving codes and symbols used in Physics; understanding appliance and device installation manuals and user guides.
- Using and understanding tables, charts and plotted mathematical relationships used to express knowledge in Physics; being able to discriminate between and translate to and from mathematical and non-mathematical languages.
- Aptly expressing and using the appropriate language of Physics and the elements involved in its symbolic representation; clearly and objectively describing the knowledge content learned by using such language.
- Being familiar with sources of information and ways of obtaining relevant information, and being able to interpret scientific news.

- Developing summaries of structured schemes reflecting the Physics topics on which attention has focused.

**Research and comprehension**

- Developing the ability to conduct research in Physics; classifying, organizing, systematizing; identifying regular patterns; observing, estimating orders of magnitude, understanding the concept of measurement, hypotheses development, testing.
- Knowing and using Physics concepts; correlating values, magnitudes, quantifying, identifying relevant parameters; understanding and using the laws and theories of Physics.
- Understanding the Physics present in the experiential world and in different pieces of equipment and technological procedures; finding out the reasons that explain "how" appliances and devices work.
- Developing and researching problem situations, identifying the physical situation, using Physics models, generalizing from one situation to the other, predicting, assessing, analyzing predictions.
- Coordinating the knowledge of Physics with knowledge contents of other fields of science.

**Social and cultural contextualization**

- Recognizing Physics as a human construction, aspects of its history and its relationship with the cultural, social, political and economic context.
- Recognizing the role of Physics in the production system, understanding the evolution of technological media and its dynamic relationship with the evolution of scientific knowledge.
- Scoping the increasing human ability made possible by technology.
- Establishing relationships between knowledge of Physics and other forms of expression of human culture.
- Being able to issue value judgements as regards social situations involving relevant aspects of Physics and/or technology.

## 5. Knowledge of Chemistry

The effective learning of Chemistry by Secondary Education students means that they should understand the chemical transformations that occur in the physical world in a comprehensive and well-coordinated manner, and thus be in a position to properly judge and assess information stemming from cultural tradition, the media or the school itself, so as to make decisions autonomously, as individuals and citizens. This learning process makes it possible for students to comprehend not only the chemical processes themselves but also the construction of a kind of scientific knowledge that is closely related to its technological applications and environmental, social, political and economic implications. Therein lies the importance of Chemistry in Secondary Education, viewed from a Basic Education perspective.

The awareness of the fact that scientific knowledge is, by definition, dynamic and changing will help students and teachers to have a much-needed critical view of science. One cannot simply accept science as being ready and finished and the concepts currently accepted by scientists and taught at schools as "absolute truth". Neither should students have the impression that there is a "science" above good and evil that scientists are trying to discover. Rather, science should be perceived as the creation of human intellect and, like any human activity, it is equally subject to ethical evaluations.

The knowledge contents disseminated through the teaching of Chemistry allow the construction of a world vision that is better coordinated and less fragmented, thus contributing for individuals to perceive themselves as participants in a constantly changing world. To that end, these knowledge contents must translate into cognitive and affective competencies and skills; indeed cognitive *and* affective, if they are to be taken as fully fledged competencies.

The acquisition of knowledge, more than sheer memorization, requires logical and empirical, as well as logical and formal cognitive skills. Students with different life histories may develop and have different readings or conceptual constructions of chemical events that may interfere in their cognitive skills. The learning process must unfold taking these differences into account. In the collective knowledge-building process that takes place in the classroom, values such as respect for classmates' opinions, group work, responsibility, loyalty and tolerance must be stressed in such a way as to make the teaching of Chemistry more effective and contribute to the development of human values that are likewise objectives of the educational process as a whole.

In sum, the cognitive and affective competencies and skills developed in the teaching of Chemistry should prepare students to make their own decisions in problem situations, thus

contributing to the development of students as human persons and citizens. In order to follow the leitmotif proposed herein for the teaching of Chemistry, by combining a system-wide vision of knowledge and student training for citizenship, it is necessary to reorganize the Chemistry contents currently taught, as well as the methodology used.

Different educational and social realities involve different perceptions of Chemistry knowledge contents and different proposals for pedagogical action. Nonetheless, even taking such diversity into account, it is possible to draw broad lines that make it possible to bring the current teaching closer to that which is desired or ideal. Given the remarks above, the content and methodological redesigning may be undertaken from two complementary perspectives, namely, one that takes into account the individual life experiences of each student, and one that takes into account a collective component in their interaction with the physical world.

In preparing and developing activities for the study of Chemistry, one should consider the development of cognitive skills, such as variable control, translation of information from one form of communication to another, such as charts, tables, chemical equations, strategy setting aimed at solving problems, decision making based on analysis of data and values/ figures, such as integrity in informing data, respecting classmates' ideas and one's own ideas and cooperation in collective work.

The skills and competencies that are to be fostered in the teaching of Chemistry should be closely linked to the contents to be developed and are an inseparable part of these contents; they should, as such, be materialized on the basis of different topics proposed for the study of Chemistry, at levels of depth that are in line with the subject matter dealt with and with students´ level of cognitive development. These skills and competencies are summarized in the table below.

**Competencies and skills to be developed in Chemistry**

**Representation and communication**

- Describing chemical transformations in non-chemical language.
- Understanding current Chemistry-specific codes and symbols.
- Translating non-chemical discourse language into the symbolic language of Chemistry and vice-versa.
- Using the symbolic representation of chemical transformations and recognizing its changes in the course of time.
- Translating non-chemical discourse language into other languages used in Chemistry: charts, tables and mathematical relations.

- Identifying sources of information and ways of obtaining information that is relevant for the knowledge of Chemistry (books, computers, newspapers, handbooks, etc).

**Research and comprehension**

- Understanding and using Chemistry concepts as part of a macroscopical (logical and empirical) vision.
- Understanding chemical events within a macroscopical (logical and formal) vision.
- Understanding quantitative data, estimation and measures; understanding proportional relations in Chemistry (proportional reasoning).
- Recognizing trends and relations derived from experimental data or other data (classification, seriation and correspondence in Chemistry).
- Selecting and using scientific ideas and procedures (laws, theories, models) to solve qualitative and quantitative problems in Chemistry, by identifying and monitoring relevant variables.
- Recognizing or proposing the research into a Chemistry-related problem, by selecting the applicable experimental procedures.
- Developing hypothetical and logical connections that allow predictions about chemical transformations.

**Social and cultural contextualization**

- Recognizing aspects of Chemistry that are relevant in human beings' individual and collective interaction with the environment.
- Recognizing the role of Chemistry in the production, industrial and rural systems.
- Recognizing the relations between the scientific and technological development of Chemistry and social, political and cultural issues.
- Recognizing the ethical and moral limits that may be involved in the development of Chemistry and technology.

## 6. Knowledge of Mathematics

By establishing a first set of parameters for the organization of the teaching of Mathematics in Secondary Education, it is our intention to accommodate the need for it to be in keeping with the development of students who may have differing motivations, interests and abilities. This will allow them to better position themselves in a changing world, while contributing to the development of the abilities that will be required from them in their future social and professional life. In a world in which social, cultural and professional needs are going through changes, all fields of knowledge require some competence in Mathematics, and the ability to understand mathematical concepts and procedures is

necessary not only to draw conclusions and present arguments but also for citizens to be able to act as prudent consumers or make decisions in their personal and professional life.

Mathematics in Secondary Education plays a key structuring role, which helps students organize their thinking and deductive reasoning; it also plays an instrumental role in that can be used in everyday life and in many specific tasks in virtually all human activities.

In its structuring role, Mathematics contributes to the development of thinking processes and attitudes, the usefulness and comprehensiveness of which go beyond the scope of Mathematics *per se*. It can foster in students a genuine problem-solving ability, in addition to furthering research habits, encouraging trust and the willingness to analyze and face new situations, thereby conveying to them a broad and scientific vision of reality and a perception of beauty and harmony, while ensuring the development of creativity and other personal abilities.

As regards the instrumental nature of Mathematics in Secondary Education, it must be viewed by students as a set of techniques and strategies to be applied in other fields of knowledge as well as in their professional activity. It would not be the case of having students acquire many sophisticated strategies, but rather to develop a sense of initiative and the sureness to adapt them to different contexts, thus using them properly and in a timely fashion.

Accordingly, it is necessary that students perceive Mathematics as a system of codes and rules that make it a language for communicating ideas and one which allows them to shape and interpret reality. Thus, numbers and algebra as code systems, geometry applied to the reading and interpretation of space, and statistics and probability to the comprehension of phenomena in finite universes are sub-areas of Mathematics that are especially linked to their applications.

Nonetheless, Mathematics and Secondary Education is not only instrumental in nature, but should also be viewed as a science, with its specific and structural features. It is important that students perceive that definitions, demonstrations and conceptual and logical linkages perform the role of building new concepts and structures from others and that they serve to validate intuitions and to attach meaning to the techniques applied.

These concepts of Mathematics as applied to Secondary Education are further complemented by the notion that, in Elementary Education, students are expected to have been exposed to several fields of mathematical knowledge and are now in a position to use and expand them. They are also in a position to more broadly develop abilities as important as abstraction, reasoning, in all of its different thrusts, problem solving, including problems

of all kinds, research, analysis and comprehension of mathematical facts and interpreting reality itself.

In conclusion, it should be highlighted that Mathematics in Secondary Education is responsible for showing students the knowledge stemming from new information and tools that are required in order to allow them to continue to learn. Knowing how to learn is the basic condition for students to continue improving themselves throughout their life. Doubtlessly, it is the responsibility of all fields of knowledge in Secondary Education to assist in the development of students´ autonomy and research ability, so that every student can trust his or her own knowledge.

Thus, the roles played by Mathematics as described earlier and the presence of technology ultimately mean that the learning of Mathematics in Secondary Education should be about more than just memorizing the results of this science and that the acquisition of mathematical knowledge must be coupled with the mastery of both practical and theoretical know-how in Mathematics.

It is essential to devote attention to the development of values, skills and attitudes in students as regards knowledge and relationships among colleagues and teachers. Concern with these aspects of students' preparation for life establishes a distinctive characteristic under this proposal, inasmuch as values, skills and attitudes are central objectives of education and likewise the elements that make learning possible or impossible in practice, regardless of contents and work methodologies. Neglecting the work on students' general preparation precludes the development of scientific thinking, as the backdrop of classrooms is made up of prejudice and misconceptions that these students bring along with them as to the meaning of learning, the meaning of mathematical exercises and the nature of the science itself. In order for this stage in the schooling process to complement the preparation started earlier and ensure actual development of the abilities that are themselves the objectives of the teaching of Mathematics, it is necessary to review and realign some of the traditionally taught topics.

Without a doubt, the essential elements in a curriculum must make up a series of topics or themes in Mathematics that have been chosen on the basis of criteria aimed at developing the attitudes and skills described above.

The central criterion is about contextualization and interdisciplinarity, i.e., the potential of a given topic to allow connections to be established between different mathematical concepts and different forms of mathematical thinking, or, still, the cultural relevance of the topic at hand, both as regards its applications within or outside Mathematics and its historical importance to the development of the science itself.

It is not enough to set goals and principles guiding the selection of themes and concepts; it is essential that methodological and pedagogical choices be made so as to inseparably bind content and form. As part of the curriculum, with the same weight as concepts and procedures, the development of values and attitudes is essential for students to learn how to learn. Omitting or neglecting to focus on this particular aspect of students´ preparation may preclude learning, including the learning of Mathematics itself. Among these values and attitudes, one might highlight the fact that students' initiative in searching information, demonstrating responsibility, trusting their own ways of thinking and substantiating their ideas and arguments is essential for students to be able to learn, communicate, perceive the real value of Mathematics as a cultural good with which to read and interpret reality and thus be better prepared to position themselves in the world of knowledge and labor.

- **Competencies and skills to be developed in Mathematics**

**Representation and communication**

- Reading and interpreting Mathematics texts.
- Reading, interpreting and using mathematical representations (tables, charts, equations, etc).
- Transcribing mathematical messages from everyday language to symbolic language (equations, charts, diagrams, formulae, tables, etc.) and vice-versa.
- Properly and clearly expressing oneself, both in one's mother language and in mathematical language, using the correct terminology.
- Producing appropriate mathematical texts.
- Properly using technological resources as production and communication tools.
- Properly using measurement and drawing instruments.

**Research and comprehension**

- Identifying the problem at hand (understanding statements, asking questions, etc).
- Looking up, selecting and interpreting information about a problem.
- Formulating hypothesis and anticipating results.
- Selecting problem-solving strategies.
- Interpreting and criticizing results in a proper situation.
- Distinguishing between and using both deductive and inductive reasoning.
- Developing and confirming conjectures, by experimentation and use of models, sketches, drawings, known facts, relationships and properties.
- Discussing ideas and developing convincing arguments.

**Social and cultural contextualization**

- Developing the ability to use Mathematics to interpret and intervene upon the real world.
- Applying mathematical knowledge and methods to real situations, especially to other fields of knowledge.
- Correlating stages in the history of Mathematics to the evolution of humankind.
- Properly using calculators and computers, while recognizing their limitations and potentialities.

## 7. Prospects and Challenges

Education in general and the teaching of Natural Sciences, Mathematics and Related Technologies cannot be established as an immediate materialization of legal definitions or as

a mere expression of one's theoretical persuasion. Above and beyond that, they also reflect the political, social and economic conditions of each period and region, and are directly relevant to cultural and productive development. The prevailing or hegemonic ideas about education and science in each period in time, be it among theorists of education, be it among the political decision-making spheres, seldom coincide with the educational practices that are actually in place in the school system, which reflects a state of affairs that is not always taken into account, where school conditions are very often different from those contemplated as ideal.

Thus, in developing educational proposals, in addition to taking into consideration the regional variables of a cultural, social and economic nature, which are quite significant in a country with the size and the social contrasts found in Brazil, one must clearly bear in mind that such proposals, whether official or not, are at best the beginning of a transformation, realignment and readjustment process. The directions of this process depend not only on the merits of the proposal, which will determine the reactions to it, but also on the previous history and all the means relied on. This was true for previous initiatives and will certainly be true for the current one.

When LDB Law 4024/61 was enacted, the school scene was dominated by traditional teaching practices, though renewal efforts were under way. The proposals for the teaching of sciences discussed for the drafting of that law were based on the need for the curriculum to respond to breakthroughs in scientific knowledge and to the new educational conceptions, thus shifting the center of attention from the pedagogical, purely logical issues to the psychological aspects of the question and appreciating the value of an active involvement of students in the learning process.

In the period that followed Brazil sought out new directions for the teaching of Biology, Physics, Mathematics and Chemistry, by following the line of action adopted by the central countries of the so called "western bloc", which sponsored the implementation of projects such as BSCS – *Biological Sciences Curriculum Study* – for Biology, PSSC – *Physical Sciences Study Committee* – for Physics, *Chem Study* and *Chemical Bound Approach* for Chemistry. Also in this period modern Mathematics emerged, bringing together basic school teaching and a specific academic reformulation of mathematical knowledge, with the emphasis now placed on the theory of sets and algebra structures. The creation and expansion of Sciences and Mathematics Centers in various States of Brazil was aimed at training teachers to develop the teaching practice proposed in the projects and their own productions, which had a significant influence on the following decade.

In the 1970's, proposals were brought forth with a view to making scientific knowledge more democratic, thereby acknowledging the importance of scientific experience not only for future scientists but also for the average citizen, in parallel with a growth in the share of the

population covered by the school system. Such growth, particularly as regards Secondary Education, was not followed by the needed teacher training, which resulted in a considerable shortage of qualified teachers, a shortage which has only worsened thus far. Without trying to underestimate the importance of the discussions during that period for a change in teachers´ mentality - which began to incorporate, even if only at a theoretical level, new objectives for teaching practices -, one must bear in mind that the actual classroom implementation of projects ended up happening only in some schools in large urban centers.

Also at that time an accelerated industrialization model imposed high social and environmental costs throughout the world, so that, particularly in Elementary Education, problems regarding the environment and human health began to be found in sciences curricula. The political and social implications of production and the application of scientific and technological knowledge were discussed, with some repercussions in classrooms. That what when the idea that technology is actually part and parcel of educational contents, side by side with sciences, was first proposed. One should not, however, mix up this idea with the real or intended introduction of technical courses aside from scientific courses throughout Secondary Education, as recommended under the above mentioned Law 5692/71, the purpose of which consists in training Secondary Education professionals and which yielded frustrating outcomes.

With regard to overall pedagogy in that period, discussions focused more deeply on the relationships between education and society, determining factors for the emergence of trends that shared the feature of attaching particular importance to socially relevant contents and to group discussions processes. At that same time and shortly afterwards, a conceptual and theoretical core of different currents was established; such currents, referred to as *constructivist*, stemmed from the basic assumption that learning is to be taken as the result of the construction of knowledge by students, a process in which students' ideas prior to the learning process are respected.

This proposal for the learning process has been enhanced to take into account the fact that the construction of scientific knowledge involves human values, is related to technology and, in a broader sense, to life in society at large, as well as the need to emphasize the conceptual, intrinsic links that pervade scientific theories and underscore the essential role of dialogue and social interaction in collective a production. This realignment has resulted in new directions that have proved relevant for scientific and mathematical education and the ideas related to it have certainly influenced the current effort to revise the contents and methods applicable to scientific education. Moreover, it will be necessary to try to fill the gap of interdisciplinary proposals for the learning process, which has contributed to an overly fragmented scientific education, particularly in Secondary Education, by resorting, for instance, to tools that are interdisciplinary in nature, such as molecular models, evolutionary concepts and conservation laws.

Fortunately, at least as regards the laws and guidelines, the provisions governing Secondary Education as established under Law LDB/96, as well as the further details and provisions set forth in Resolution CNE/98, point towards a revision and update in the proper direction. Several articles contained in that Resolution focus exclusively on providing guidance to the learning process with a view to attaining greater contextualization, actual interdisciplinarity and a broader human, rather than merely technical, orientation, and recommend a closer relationship between theory and practice in the learning process.

The main challenges for the intended update in the learning of Science and Technology in Secondary Education include proper teacher training, development of appropriate instruction materials and even a change in the stance taken as to the structure adopted by schools regarding individual and collective learning, as well as an assessment of such practices.

This can be said to be true of every school-based science learning since scientific and technological initiation in the first grades of Elementary Education. The significance of these shortcomings, however, is made worse in Secondary Education, the end-stage of Basic Education, currently marked by the astonishing pace of economic and cultural changes, further accelerated by a scientific and technological revolution that is not fully accompanied by developments in the educational sphere.

Actually, one should not at all intend to place the hope for such parallel development simply on greater scientific culture on the part of teachers, in that they, after all, should not be viewed as the ultimate holders of all contemporary scientific knowledge. It is important to stress the fact that curriculum updating should not mean syllabus complementation by merely adding topics to a list of subject matters. On the contrary, it is important to overcome the encyclopedic vision of the curriculum, which hinders true updating of teaching practices, as it establishes an order which is both artificial and arbitrary and one in which closed pre-conditions prevent the learning of modern-day contents before completing the classic learning contents and in which "applied" or technological contents would only have a place in the curriculum after "pure" science has been extensively mastered. This vision of the curriculum hampers not only the organization of school contents but also teacher training.

It is obvious that an appropriate teacher training is required for Biology, Physics, Chemistry and Mathematics teachers, in order for the modernity of their knowledge not to result in superficiality or cognitive impoverishment. Further, a more effective, scientific and pedagogical development calls for changes in schools themselves, in such a way as to foster new attitudes on the part of both students and the community. It is necessary to change misconceptions – culturally disseminated throughout society – that students are the passive party, that teachers are the active parties and that the school is nothing but the stage on

which the teaching process takes place. Where the learning of Sciences and Mathematics is aimed at not only furthering competencies, such as the mastery of concepts and students´ ability to use formulae, but also at developing attitudes and values through student-oriented activities, such as discussions, readings, observations, experimentations and projects, the whole school must take on a new methodological stance; one that is difficult to implement, for it requires changes in long established, deep-seated teaching habits.

Particularly in the field of sciences, active learning is at times mistakenly mixed up with some kind of sheer and simple experimentalism, which is neither workable nor recommendable, as any given activity must involve many other aspects beyond observations and measures, such as dialogue or students´ involvement in collective discussions and autonomous reading tasks. It is not enough, nonetheless, that such activities be recommended. They must further prove necessary and be made feasible as part and parcel of the pedagogical project. This depends on the schools, and not only on teachers. Particularly in the case of Mathematics, given the fact that it is both a language and a universal tool, distortions in the learning process very adversely impact the learning of other sciences.

One can see, for example, just how significant the pedagogical redesigning would have to be in most schools in order for them to embrace concepts and the carrying out of collective, interdisciplinary work projects as a regular component in their efforts to further scientific and technological education. Among other things, the school community should be involved in designing the pedagogical project and, under many circumstances, scientific and educational support from universities or other professional/ academic development centers may prove necessary. On the one hand, the complexity of the topics at issue may indeed warrant such support as an essential input. On the other hand, teacher pre-service and continuous training programs in the fields of Natural Sciences, Mathematics and Technology, as conducted by such centers or universities, could prove more effective if carried out in line with the needs identified in teachers' practice.

In this field of knowledge, which would more traditionally be that of Sciences and Mathematics, fostering a new pedagogical stance is as difficult a task as introducing new, more significant contents. Simply mentioning "technology" alongside "science" does not foster a new stance and new contents. Usually, one does not go beyond general and abstract discourse in conceptualizing technology, without even explicitly stating how it demands knowledge and hence scientific education, or through which processes it furthers scientific development.

With the advent of what has been termed the post-industrial society, the dissemination of information technologies in products and services, coupled with the increasing complexity of individual and collective equipment and the need for increasingly elaborated knowledge for social and productive life, technologies need to find their own place in regular school-based

learning, similarly to what happened in the field of Sciences many decades ago, and should also be viewed as a process, rather than simply a product. Technology in school-based learning must likewise become a tool geared towards citizenship, social life and work. In Secondary Education, familiarity with modern editing techniques and democratic use of personal computers is but one example of real experiences that must be ensured, thus overcoming the "discourse on technologies" of a questionable usefulness. It is necessary to identify, in Mathematics, Natural Sciences, Human Sciences, Communications and Arts, the elements of technology that are essential to them and develop them as living contents, as objectives of education in and of themselves and, at the same time, as means to that end.

Incorporating these elements into school practices, some of which can be promptly incorporated, is more feasible a task than one may imagine. Because they are already relatively trivial consumption objects, video cameras and computers are currently becoming cheaper than microscopes and other conventional experimentation equipment, the trend being that they will become increasingly affordable. This will, in turn, soon do away with the barriers that still stand against the incorporation of these tools into the learning process, be it as an indirect means in the handling of texts and teaching-oriented pedagogical videotapes suitable to each context, be it as a direct means and the purpose of the learning process, used by students in the production of texts and videotapes in what can thus be described as a practical learning approach.

The development of projects conducted by groups of students under teacher supervision may bring about the opportunity to use these and other technologies, especially in Secondary Education. This, of course, does not come spontaneously by itself, but rather as one of the initiatives that are part of the pedagogical project in each school; these projects may even be encouraged through use of educational networks. In order to prepare and develop such a project, one might envisage the advantages of previously clustering together the courses of a given area, such as Mathematics and Natural Sciences, to then coordinate them with the other fields of knowledge.

Changes in the learning process such as these will require and foster new assessment concepts that will have specific implications for the field of Sciences and Technology but which will likewise have broader repercussions in all other fields and courses. There are quite specific assessment issues that should be addressed in each course in the context of its specific teaching practices, but there are also more general aspects that may be stated beforehand. An assessment exam that is conducted in the form of an isolated exam only is improper, for it must actually be a continuous process serving the purpose of providing ongoing guidance to teachers´ practice. As part of the learning process, it must include records and comments on the collective and scientific production of knowledge and, for that very reason, it should not be a procedure applied on students but rather a process that relies on their participation. An assessment exam that requires students to repeat what has

been taught is poor in that it should ideally include situations in which students use and see that they can truly apply the knowledge contents, values and skills they have developed.

These and other educational resources and tools are virtually universally valid, though they may take on specific features and different emphasis in the teaching-learning process of Sciences and Mathematics. For that reason, it is appropriate that we should try to at least list them, illustrating how they can be used by the several different courses.

The various sciences, Mathematics and technologies share common features, given the type of rigor they require, the type of correspondence between their formulations and observable events, and the type of practical sense that they often show; this is also a significant part of the teaching practice they use, although with different emphasis, as adopted by the different courses in this field. In part, this can be observed from the recently drafted history of the evolution in the teaching of these courses, which shows that they went through the same stages and experienced the same trends more or less at the same time. If it is true that, to a certain extent, this reflects general trendlines in education, it is likewise true that often the teaching of Sciences has been in the forefront of these trendlines, especially over the past fifty years.

Without meaning to establish a hierarchy of priorities, we will briefly describe some aspects, concepts or teaching tools that are common to the teaching of all Sciences and Mathematics, starting with considerations on the role of teachers. Being knowledgeable of the contents of their course and convinced of the importance and the possibility of all students learning them, teachers are precisely the ones who select instruction contents that are in line with the objectives set in their pedagogical project; teachers problematize such contents, foster and mediate the educational dialogue; they help create favorable conditions for students to take on the center of the educational actions and thus become learning agents; they link the abstract and the concrete, as well as theory and practice; and see to the continuous adaptation of language according to students' increasing abilities, thus avoiding incomprehensible speech and symbols, such as unnecessary and discouraging repetitions.

Sudents´ previous knowledge, a topic that has mobilized educators, especially over the past two decades, is particularly germane to the learning process in Sciences and Mathematics. Students come to school and bring with them their own concepts about the things they observe and the autonomously developed models with which to explain their experienced reality, including events of a scientific interest. It is important to take such knowledge into account in the pedagogical process, as an actually pedagogical dialogue can only take place when and if there is a true contrasting of visions and opinions. The learning of Sciences is a transition process from intuitive vision, common sense or self-elaboration to a scientific vision built by students as the result of a clash of visions.

Educators focusing on Sciences and Mathematics, at least on the conceptual front, unanimously agree on the need for active and interactive learning methods to be adopted. Students succeed in learning through a complex process, one that involves personal elaboration, to which the teacher and the school contribute by allowing students to communicate, position themselves in their group, discuss their own comprehension of things, learn to respect others and to make themselves respected, by affording students the opportunity to develop explanatory models, lines of reasoning and tools with which to verify contradictions; by creating situations in which students are prompted or challenged to participate and call issues into question; by appreciating the value of collective activities that allow joint discussion and elaboration of ideas and practices; by developing entertainment activities in which students are expected to be challenged by the knowledge game, and not just by other participants.

Not only in Mathematics but also and particularly in this course, problem solving is an important teaching strategy. Facing problem situations that are new but still in line with the tools that they already have or that they may acquire in the process, students learn how to develop an approach strategy to tackle the problem, by establishing relationships, checking for regular patterns, by using their own mistakes to seek out new alternatives. They develop a research-oriented spirit by learning how to look up information, experiment, organize data, systematize results, validate solutions. They develop their own reasoning ability and acquire self-confidence and a sense of responsibility; and, finally, they expand their autonomy and ability to communicate and argue successfully.

The learning process whose starting point is the world of experience shared by both students and teachers, and which actively looks into the real natural or social environment or uses the practical knowledge of experts and other professionals, develops significant learning in a more extensive fashion by creating the conditions for an actually interdisciplinary dialogue, as opposed to abstract discourse about knowledge as a teacher-only privilege. Moreover, it brings the school closer together to the real world, as it comes into contact with the natural, social, cultural and productive reality, through field visits, interviews, factory tours, environmental outings. Such a learning system also attaches immediate sense to knowledge and provides a foundation for its subsequent abstract expansion.

In the learning of Sciences, Mathematics and Technologies, experimentation, whether through demonstration or through observation and handling of everyday students' situations and equipment, and even under laboratory conditions, is in and of itself different from the experimentation aimed at scientific discovery, and it plays a particularly important role when it affords students different and simultaneous means for qualitative and quantitative perception, handling, observation, confrontation, doubt clearing and conceptual construction. Experimentation also allows students to gather significant data in the light of

which they will be in a position to verify or bring up explanatory hypothesis and, preferably, draw forecasts for experiments yet to be conducted.

Sciences and technologies, as well as the learning thereof, may make use of a broad variety of languages and resources, means and forms of expression, such as the more traditional texts and lectures in the classroom setting. Texts are not always essential but may be used to students' advantage once they have been deemed suitable as an introduction to the study of a given content, a summary of the knowledge content imparted or as supplemental reading. Texts contain philosophical constructions, world visions, and students should be encouraged to read beyond words, to learn, evaluate and even object to what they read. The reading of a text should always be one of the resources of a class, but not the main one. Thus, it is incumbent on teachers to problematize texts and provide new information leading to the comprehension of the intended concept.

As to the more traditional lecture format, it is very often the only teaching format used, while leaving the impression that it is always a tiresome, uninteresting pedagogical technique. Not necessarily so. The lecture format is only one of the many means available and should ideally mean time for dialogue, for the exercise of creativity and the collective work in the development of knowledge. Through this technique we can, for instance, provide preparatory input to feed into a discussion, game or other classroom activity, analysis and interpretation of data gathered in studies of the surrounding environment and in the laboratory setting.

Classes and books, nevertheless, do not under any circumstances summarize the huge diversity of pedagogical resources, means and strategies that can be put to use in the teaching of Sciences and Mathematics. The use of this diversity is key for the learning process because tables, charts, drawings, photographs, video clips, cameras, computers and other pieces of equipment are not simply means. Mastering how to operate them is also one of the objectives of the teaching of Sciences, Mathematics and Technologies. Certain aspects require images, and preferably dynamic images; others require calculations or tables and charts; still other aspects may require analysis equations, and the redundancy of means always proves a plus in ensuring the reliability and/or reinforcement of the learning process.

Yet another methodological aspect to be taken into consideration in the teaching of Sciences in general, possibly with special emphasis on Chemistry and Physics, has to do with quantitative and qualitative approaches. The study should always start from the qualitative approaches and only then evolve to introduce a quantitative treatment. The latter must be done in such a way that students perceive the quantitative relations without needing to use algorithms. Once students understand the matter at hand they will be able to develop their own algorithms.

The assessment exam itself must also be treated as a teaching strategy aimed at furthering the learning of Sciences and Mathematics. The assessment exam may take on and play an essentially development-oriented role. As such, it will prove conducive to students' personal progress and autonomy and will be incorporated into the teaching-learning process to allow students to be aware of their own progress regarding knowledge contents, and to allow teachers to control and improve their pedagogical practice. Since the contents to be learned cover the spheres of concepts, abilities and attitudes, the purpose of the assessment exam consists in reflecting students' progress in all of these spheres. Fully in line with the teaching practice undertaken, assessment exams should provide information students´ knowledge and comprehension of concepts and procedures; their ability to apply knowledge to everyday problem solving and to use the languages of Sciences, Mathematics and Related Technologies to communicate ideas; as well as thinking skills such as those used in analyses, generalizations and inferences.

The learning of Sciences, Mathematics and Related Technologies may unfold in such a way as to encourage actual participation and social responsibility on the part of students, by discussing possible interventions in the reality in which they live, ranging from the dissemination of knowledge to environmental control actions or significant interventions in the neighborhood or location, so that students feel that they actually hold a significant kind of knowledge.

Collective projects are particularly appropriate for this educational purpose, involving groups of students in production projects or those aimed at disseminating knowledge and focused on broad themes, such as buildings and housing, vehicles and transportation, or the environment, sanitation and pollution, or even the generation, distribution and social use of energy, all of which are usually interdisciplinary themes.

A comprehension of the relationship between the learning of Sciences, Mathematics and Related Technologies and socially relevant issues is both a means for teaching and an objective of education. This can be pursued through activities such as the projects suggested above, or by conducting a historic analysis of the development process of Sciences and Mathematics. In this regard, the history of Sciences is an important resource. The history of Sciences and Mathematics, nevertheless, is relevant for a kind of learning that goes beyond social overtones or relationships, as it also illustrates the development and evolution of concepts to be learned.

The convergence between the means used for learning and the intended educational objectives must be given special attention as something to be furthered in the pedagogical project of each and every school, in all aspects of the education process. When, for instance, collective activities are proposed, involving cooperation among students and the development of joint projects, the idea is to make the learning of Sciences and Mathematics

more effective, but, at the same time, the purpose is to foster the learning of collective and cooperative work as a human competence. In fact, real life tasks that do not require precisely joint and cooperative activities are absolutely rare.

When, for instance, active learning methods are proposed in which students become active players in the educational process, as opposed to passive participants, the idea is to make sure students have actually appropriated knowledge for themselves, or even developed knowledge themselves. But, moreover, the intended purpose is to educate students for initiative, as the kind of citizenship we want to build involves participation and cannot materialized in passivity.

Each of the pedagogical elements mentioned in the above sequence, which is admittedly not exhaustive, may be viewed as a means and an end, as a process and a product of education, and should therefore be encouraged with caution and an awareness of the fact that we are dealing with necessary elements, and not a procedure to which educators might occasionally resort for lack of another one. Even computers, cameras and other resources briefly alluded to must be viewed as more than learning tools, for when students are able to learn how to use them as work, life and ongoing development tools, the goals of Basic Education will thus be fully complemented.

In conclusion, in discussing the ends and means of education, it is appropriate to add certain ingredients that often fall into oblivion when it comes to the teaching of Sciences, Mathematics and Related Technologies, namely, an appreciation for the value of culture and the joy of learning. When schools foster a learning environment where tasks are performed with enthusiasm, challenges overcome with passion and where participants cooperate and ethics pervades procedures, they are building citizenship through their practice, by providing the conditions required for the development of fundamental human values that are likewise central to the ultimate objectives of education.

## Chapter IV

## Human Sciences and Related Technologies

### 1. Introduction

In this field, which also encompasses Philosophy, the knowledge of Human Sciences is expected to be translated into a critical and creative consciousness, capable of bringing forth appropriate responses to current problems and novel situations. Among these, the following should be highlighted: expanding the exercise of citizenship, which involves knowledge, use and historic production of citizens´ rights and duties, and the development of a civic and social consciousness, involving taking other people into consideration in every decision and attitude of a public or private nature.

Learning in this field of knowledge is expected to develop competencies and skills that allow students to: understand the society in which they live as a human construction that is constantly being reconstructed in the course of generations, in a continual process marked by its historic component; understand the space occupied by man as a space that is constructed and consumed; understand human sociability processes as collective processes that determine public spaces and likewise have implications for the constitution of individual identities; construct themselves as social players who intervene in society; appreciate the meaning of social processes that spearhead the ongoing social flows, as well as the meaning of their intervention in this process; be able to evaluate the impact of technologies on the development and structuring of societies; and appropriate for themselves the technologies produced or used in this field of knowledge.

### 2. The meaning of field-specific learning

Rethinking the role to be played by Human Sciences in basic schooling and organizing them in a field of knowledge in Secondary Education means recovering the so-called "Humanities", a generic name encompassing languages and classical culture, vernacular language and literature, the main modern foreign languages and their respective literatures, Philosophy, History and Fine Arts. Under the pressure of the immediate needs of a civilization

increasingly grounded on Natural Sciences and the technologies ensuing from them, both Humanities and Human Sciences have lost prestige and the space they used to hold in society and in schools.

The current juncture, however, is one conducive to the restructuring of a curriculum in which the study of Sciences and Humanities be complementary rather than mutually excluding. The purpose is to reach a synthesis between humanism, science and technology that makes it possible to overcome the positivist paradigm as regards science, culture and history.

In this turn of century and millenium, amidst enormous breakthroughs brought about by science and technology but also amidst sources of anguish and uncertainty, Brazilian society - as represented by its educators of several different schooling levels in a dialogue with government officials - is creating the opportunity to update its school-based education, endowing it with the resources with which to cope with the imperatives of a technology society without neglecting the much needed recovery of the humanistic tradition.

Without losing sight of the historic dimension and leaving behind any pretense to revisit the 15th or 19th centuries, this recovery of the humanistic tradition is made possible through the feasible ideal of a synthesis between humanism and technology in which man's hand and the computer keyboard both serve the purpose of constructing a more just and mutually supportive society.

That is precisely the imperative purpose set forth in the Law on National Education Guidelines and Bases enacted on December 20th 1996, as it establishes the ultimate purpose of education to be "*students' full development and preparation for the exercise of citizenship and qualification for work"* (Article 2); and as the purposes of Secondary Education *"the consolidation and deepening of knowledge"*; " *basic preparation for work and citizenship"*; *"students ´ enhancement as human persons, including training in ethics and development of autonomy and critical thinking"*; and *"the comprehension of underlying scientific and technological foundations of production processes"* (Article 35).

In turn, the National Curriculum Guidelines for Secondary Education approved by the Basic Education Chamber of the National Council on Education and ratified by the Ministry of Education ensure the resumption and updating of a humanistic education, as they provide for a school and curriculum organization that is grounded on esthetic, political and ethical principles.

In so doing, the Guidelines reinterpret the principles proposed by UNESCO's International Commission on Education for the 21st Century, governed by the following concepts: learning how to know, learning how to do, learning how to live with and learning how to be. The

**esthetics of sensitivity**, which overcomes standardization and encourages creativity and an inventive spirit, is to be found in the concept of **learning how to know** and **learning how to do** as two moments of the same human experience, thus overcoming the false dichotomy between theory and practice. The **politics of equality**, which establishes the Rule of Law and Democracy as reigning principles, is embodied in the concept of **learning how to live with**, in the construction of a mutually supportive society through cooperative and non-individualistic actions. The **ethics of identity**, required to meet the challenge of an education geared towards the construction of responsible and supportive identities, in line and committed with contemporary realities, both in time and space, stems from the premise of **learning how to be** – the ultimate objective of a pedagogical intervention that educates students and is not confined to solely conveying ready-made knowledge.

Such principles form the foundation that attaches meaning to Human Sciences and Related Technologies as a field of knowledge. Work and production, organization and social life, the construction of "self" and "otherness" are classic and permanent themes in Human Sciences and Philosophy. They are the subject of a historic, geographic, economic, political, legal, sociological, anthropological, psychological and, above all, philosophical knowledge. Given their very nature, they involve an interdisciplinary organization. Grouped and regrouped at the discretion of the school itself into specific courses or projects, programs and activities that overcome disciplinary fragmentation, such themes and subjects, instead of constituting an endless list of contents to be conveyed and memorized, are the very reason for the study of Human Sciences in Secondary Education.

Reflecting the height of these concerns, philosophical contents have now returned to the curriculum. As regards the tradition of studying Humanities, it is in the field of Human Sciences and Related Technologies that they are to be included. However, one should take into account the transdisciplinary nature of Philosophy, both as Philosophy of Language and as Philosophy of Science. Likewise, History, which should be included as History of Languages and History of Sciences and Techniques, not from the traditional perspective of Intellectual History - limited to narrating the biography of scientists and listing their inventions and discoveries -, but rather from the perspective of a a new Cultural History that frames thinking and knowledge as part of the negotiations and conflicts involved in life in society. Philosophy and History thus become tools for the comprehension of the social and cultural meaning of languages, sciences, both natural and human, and technology.

The presence of technologies in the field of Human Sciences is based on an expanded understanding of technology itself, not only as a product but also as a process. If, on the one hand, as a product, technologies point more directly to Natural Sciences and Mathematics, on the other hand, as a process, they pertain to the use and reflections about them by all three fields of knowledge.

However, a broader understanding of technology as a social phenomenon allows one to observe the development of diverse technological processes supported by knowledge contents in Human Sciences. Above all, it is necessary to draw a distinction between Human Sciences technologies and Natural Sciences technologies to reflect their relevant specificities. The latter produce "hard" technologies in the form of material tools and instruments, whereas Human Sciences produce ideal technologies, i.e., more directly related to thought and ideas, such as those involving information management, sorting and handling based on sociological approaches. Yet another aspect that allows combining technologies to Human Sciences pertains to the use, by the latter, of technologies stemming from other fields of knowledge, such as the utilization of satellites and airborne photography in cartography applications. Finally, Human Sciences as a field of knowledge is further tasked with furthering a reflection on the relationships between technology and culture taken as a whole, so as to attach a new dimension to both human production and everyday life. This includes the role of technology in economic and social processes and the impacts brought about by technologies on humankind, such as, for instance, the perception of a fleeting or endlessly present time, as a result of speedier information flows.

Doubtlessly, it is by referring to concrete rather than abstract contexts that one is able to attach meaning to technologies in the field of Human Sciences. As schools organize their curriculum, technology, whether taken as a theme or an application, a product or a process, may constitute an excellent resource for a contextualized treatment of knowledge in this field.

- **Field-specific competencies and skills**

**Representation and communication**

- Understanding the importance of contemporary communication and information technologies for planning, management, organization and strengthening of team work.

**Research and comprehension**

- Understanding the cognitive, affective, social and cultural components that make up one's own and other people' s identity.
- Understanding society, its origin and transformation, as well as multiple intervening factors as a result of human action; perceiving oneself as a social player, and social processes as driving forces of different groups of individuals.

- Understanding the underlying principles of technologies related to knowledge of individuals, society and culture, including those involved in planning, organization, management, team work, and relating them to the problems to be solved.

**Social and cultural contextualization**

- Understanding social development as a process of appropriation of physical spaces, and human life relationships with the surrounding environment, including its political, cultural, economic and human implications.
- Understanding production and the historic role of social, political and economic institutions, by relating them to the practices of different social groups and players, to the principles governing life in society, to rights and duties arising from citizenship, to justice and to the distribution of economic benefits.
- Translating knowledge on the human person, society, the economy, social and cultural practices into an attitude of questioning, analyzing, problematizing and actively engaging in novel situations, problems or issues in one's personal life, as well as in social, political, economic and cultural life.
- Understanding the impact of technologies related to Human Sciences on one's personal life, production processes, knowledge development and social life.
- Applying Human and Social Sciences technologies in the school setting, in the workplace and in other relevant contexts in students' life.

## 3. Knowledge of History

History, as a school course that is part and parcel of Human Sciences and Related Technologies, allows students to broaden their studies of contemporary problems, by situating them in different time scales, thus providing a framework for a reflection on the possible and/or required changes and/or continuities.

Including History among the other courses that make up the so-called Human Sciences allows consolidation and deepening of those themes studied in Elementary Education, thus reinterpreting aspects of life in society and the role of individuals in transforming the historic process and thoroughly completing students' comprehension of the relationships between freedom (action by individuals as historic subjects) and necessity (actions determined by society, itself the product of history).

The role to be played by the courses that make up Human Sciences, at this level of teaching and for the historic moment we are currently living through, must be taken in a broader perspective and involves the development of an educational culture. We currently live in a

society characterized by the prevalence of the consumption myth and by technologies, with seemingly very fast transformation paces, with information coming from different sources, and also marked by the fragmentation of knowledge on individuals and social life.

Political conceptualizations and those pertaining to human actions in the public and private spheres, as well as man-nature relations, are undergoing changes. The scientific paradigms that provide the fundamental underpinnings for these concepts are being strongly called into question by modern-day realities that praise and attach priority to technological innovation, but which nevertheless fail to solve old problems, such as inequalities, prejudice, difficulties in perceiving "others" and the several different forms of social life and social relations. Widespread dissemination of scientific rationality did not entail the elimination of forms of world and human representation subject to varying dogmas and types of mysticism, including diverse religious beliefs, very often contradictory and paradoxical in view of everyday technologies.

These remarks regarding the uncertainties and myths experienced by today's youth require a more accurate description of the educational role to be played by this field of knowledge, so as to ensure a more **humanistic** Secondary Education that is able to preclude the establishment of a solely utilitarian and professional vision of school courses.

As regards school-based knowledge of History, the current curricula are reflective of the paradigm transformations in a field involving historic knowledge as a whole. The links between the history that is taught and academic production have drawn closer as of the late 1970s and have often established fruitful relationships, while nonetheless highlighting the difficulties in attaining consensus and/or simplified definitions of teaching contents and methods.

The debate on historiography has proved intense, involving diverse approaches to old themes and the inclusion of new subject matters reflecting the multiple facets of human production and grounded on multiple theoretical and methodological foundations.

Social and cultural history has imposed itself in such a way as to reconstrue economic and political history, thus making it possible for previously silenced voices of social groups and classes to now emerge. Women, children, diverse ethnic groups have been the subject of studies that attach a new dimension to the private and political spheres of everyday life, individuals' actions and roles, reconnecting subjectivity to the fact that they are the product of a given historic time in which junctures and structures are found. Current historiographic production aims at establishing dialogues with its time, underscoring the saying according to which "every form of history is born to its own time", while acknowledging the fact that it is the result of many schools of thought.

Research in History currently endeavors to establish co-relations between micro- and macro-history, seeking, in the unique, specific nature of events, the generalizations that are required to comprehend history as a process. In correlating specific and general elements, different forms of human action and records are retrieved, both in those spaces that are traditionally viewed as related to power, such as the State and official institutions, and in private spaces of factories and workshops, households and streets, festivities and upheavals, wars between nations and daily conflicts over survival, mentalities and their persisting values and beliefs, and transformations arising from the modernity of urban life and its technological apparatus.

The teaching of History, as developed through specific activities and their different time scales, particularly with respect to contemporary affairs and long term issues, may prove conducive to a reassessment of the values prevailing in today's world, a clear-cut perception of different paces of historic transformations, a reinterpretation of the present as part of the *continuum* of processes that forged it, and the construction of identities towards past generations.

- **Competencies and skills to be developed in History**

**Representation and communication**

- Criticizing, analyzing and interpreting sources of documentation of different nature, and recognizing the role of different languages, different social players and the different contexts involved in their production.
- Developing analyses and interpretations in writing about historic processes, working on the basis of categories and procedures that are specific to the historiographic discourse.

**Research and comprehension**

- Taking the different concepts of time and the different ways of setting periods in the chronological timeline in a relative perspective, recognizing them as cultural and historic constructions.
- Correlating continuity and permanence, as well as rupture and transformation in historic processes.
- Constructing one's personal and social identity in a historic dimension, following recognition of the role played by individuals in historic processes both as subjects and products of same processes.
- Acting on processes of social memory construction, on the basis of a criticism of the different socially established "places of memory".

**Social and cultural contextualization**

- Bringing the several different productions of culture – languages, arts, philosophy, religion, sciences, technologies and other forms of social production – into the historic contexts of their establishment and meaning.
- Correlating different moments in history with different duration paces and relationships of succession and/or simultaneity.
- Comparing current problems vis-à-vis those of other times in history.
- Taking a stance on current events by interpreting their relationship with the past.

**4. Knowledge of Geography**

Having become an autonomous science in the 19th century, Geography, by the end of the 20th century, stands as the subject of renewed interest. The renewal of the teaching practices in Geography in Brazil started in the 1970s and is related with a broader crisis that affected all sciences following World War II.

The major changes were brought about by the technical and scientific revolution, the globalization of the economy and the environmental problems that, in all, attached a new meaning to knowledge contents in Geography. From a merely descriptive (and even burlesque) science to the status of Critical Geography, the discipline has come a long and turbulent way.

Now redefined as a social science, it is important that Geography professionals think of ways to establish relationships through interdependency, by connecting phenomena through linkages between human subjects and their interests in which contextualization is a must.

Further, given the globalization process currently under way, a new world order involving new conflicts and sources of tension, the crisis of nation-States, the formation of economic blocs, the blurring of territorial boundaries of a great deal of human groups, environmental issues that attach new meanings to society as a whole and to its building blocs, what kind of contribution should the knowledge of Geography make towards the full development of students?

Firstly, it is necessary to give up a vision purely based on a description and memorization of "The Earth and Man", coupled with overlapping information on relief, climate, population and agriculture, for instance. On the other hand, it is necessary to overcome a "denunciation-oriented" doctrinal model that takes matters as if society were a ready-made reality in which all problems were solved *a priori*.

The technical and scientific revolution does not provide recipes and brings along with it speedy transformations that cannot be usefully dealt with through a simple analysis of their appearance.

In seeking to understand the economic, political, and social relations and their related practices at the local, regional, national and global spheres, Geography focuses on, and in fact contributes to, envisaging space as a totality in which all **day-to-day** relations take place and where social networks are established in the above-mentioned spheres.

In Elementary Education, the role of Geography consists in providing spatial initiation to students, at different scales and configurations, by providing them with sufficient training to handle concepts such as landscape, space, nature, State and society. In Secondary Education, students must develop competencies that allow them to analyze reality and disclose causes and effects, the intensity, heterogeneity and spatial context of phenomena that shape each and every society.

The distinction drawn herein lies in the fact that one should not understand Secondary Education as if it were merely a continuation of Elementary Education or an abridged version of an undergraduate course. Secondary Education is time for broadening the prospects for knowledge that is structured and mediated by schools; knowledge that results in the autonomy citizens of the next millenium will require. Following the three philosophical principles underlying the curriculum structure, namely, esthetic, political and ethical principles, Geography contributes to such development, allowing students to:

- perceive and take into account space-related phenomena, recognizing them not only from the standpoint of the society-nature dichotomy, but rather viewing them as the product of relationships that shape their everyday life, establish their "spatial sphere" and interconnect them to other spatial configurations;
- recognize economic, social and cultural contradictions and conflicts, which makes it possible for them to compare and evaluate the quality of living, habits, ways of using and/or tapping into material and human resources in the pursuit of respect for differences and a more egalitarian social organization;
- become active players in the teaching-learning process so as to fulfill their role at the local, regional, national and global spheres. The autonomy made possible by one´s identity a citizen is required for one to show responsibility towards one's "place in the world" through the respective territorial identity.

Secondary Education should provide guidance and develop citizens capable of learning how to know, learning how to do, learning how to live with and learning how to be. In other words, it should seek a means to change tutored individuals unduly treated as children into persons who fully exercise their citizenship and whose knowledge translates into cognitive,

social, affective and psychomotor competencies and into sensitivity and solidarity values that are required to improve life in this Nation and on this planet.

It is our understanding that by identifying oneself with one's place in the world, i.e., the space of one's everyday life, students are able to establish comparisons, perceive impasses, contradictions and challenges from the local to the global level. By taking a problem-oriented approach, rather than an explanation-oriented one, students will be in a position to better cope with the volume and the speed of current flows of information and transformations, which, if taken in a superficial manner, may contribute to individualism and alienation.

In view of the revolution currently under way in the world of information and communication, labor relations and the new technologies that have emerged and been established over the past decades, it is fair to say that 21st century students will find in Geography an important scientific source for their development as citizens who deal with new ideas and interpretations at scales where the local and the global components are defined in a network that actually pervades communication among people, functions, words and ideas. Taken as such, Geography may turn possibilities into potentialities, thus (re)constructing Brazilian citizenry.

Geography is by definition interdisciplinary and has, for some decades now, given up the pretense of becoming a science of synthesis, i.e., a science capable of explaining the world all by itself. Hence the need to reach beyond its conceptual limits and pursue an interface with other sciences without losing its identity and specificity.

In an effort to establish unity amidst diversity and to open itself to new possibilities through a vision of the whole, Geography may prove of great assistance in undoing factual, out-of-context fragmentation. Its purpose of conceiving the space as a totality that pervades all day-to-day relations and where social networks are established at different levels requires such an interdisciplinary effort. The space and its players are made up of interactions, and the study thereof must therefore be interdisciplinary in nature. Knowledge of Geography stems from collective work that likewise involves knowledge of other fields.

Accordingly, Geography may be closely coordinated in an interdisciplinary fashion with Economics and History in dealing with issues regarding the processes at stake in the international labor division and the formation of economic trade blocs. Contemporary issues, such as the economic crisis, the globalization of the financial system, the power of the State and its relationship with the economy and the new spatial consequences of social inequalities, may be addressed by Geography as it interfaces with Economics and Sociology. The spatial component in environmental problems and biotechnology is conducive to a closer interaction with Biology, Physics, Chemistry, Philosophy and, again, Economics.

**Competencies and skills to be developed in Geography**

**Representation and communication**

- Reading, analyzing and interpreting Geography-specific codes (maps, charts, tables etc.), taking them as elements for the representation of spatial events and phenomena and/or elements that have a significant spatial dimension.
- Recognizing and applying cartographic and geographical scales as means of organizing and learning about the location, distribution and frequency of natural and human phenomena.

**Research and comprehension**

- Recognizing spatial phenomena on the basis of selection, comparison and interpretation, and identifying the specific or general features of each place, landscape or territory.
- Selecting and preparing research plans that involve an observation of territorial formation and transformation processes, bearing in mind labor relations, the introduction of techniques and technologies and the establishment of social networks.
- Analyzing and comparing, in an interdisciplinary approach, the relationships between preservation and degradation of life on the planet in the light of knowledge of its dynamics and the globalization of cultural, economic, technological and political developments that impact nature at the local, regional, national and global levels.

**Social and cultural contextualization**

- Recognizing the essence of the current geographical space in its apparent, visible and concrete forms, i.e., the historic processes unfolded in different times and contemporary processes and body of practices by different players that result in deep changes in spatial organization and content.
- Understanding and applying basic Geography concepts in everyday life.
- Identifying, analyzing and assessing the impact of natural, social, economic, cultural and political transformations in one's "place in the world", by comparing, analyzing and synthesizing the density of relationships and transformations that make reality a concrete experience.

## 5. Knowledge of Sociology, Anthropology and Politics

The overall objective of the study of Social Sciences in Secondary Education consists in introducing students to the main conceptual and methodological issues in Sociology, Anthropology and Politics. The starting point of these sciences was a reflection on changes in social, economic and political conditions dating back to the 18th and 19th centuries. This context, marked by major changes, had a significant impact on the formation process of the major issues that were addressed by Sociology, Anthropology and Politics and which developed in the course of the 19th century, in an attempt to solidify its scientific discourse.

Law 9394/96 establishes the construction of students' citizenship as one of the key purposes of Secondary Education, thus highlighting the importance of the teaching of Sociology in Secondary Education. Because sociological knowledge is basically aimed at researching, identifying, describing, classifying and interpreting/ explaining all events pertaining to social life, it can endow students with the tools that will, in turn, allow them to read the complexity of social reality.

Thus, through systematized sociological knowledge, students are able to develop a more reflective and critical stance in view of the complexity of today´s world. By better understanding the dynamics of the society in which they live, students will perceive themselves as active players, endowed with political influence and the ability to foster changes and, through a full exercise of their citizenship, even help put into practice structural changes that are conducive to a fairer and more supportive model of society.

On the other hand, the teaching of Sociology on Secondary Education must likewise provide theoretical tools for students to understand the capital internationalization process as related to the successive technological evolutions; indeed a broad processes that ended up breeding a new political, social and cultural order.

Thus, relevant social institutions, such as the **family** and the **State**, have taken on new meanings: new players have emerged and the scenes have expanded. The core-centered, patriarch-led family model has gradually lost ground in view of the achievements by the feminist movement itself. Under the Rule of Law, emphasis is placed on the fact that citizens and the State must have and exercise both rights and duties. One should also take into account the role played by Non-Government Organizations as a new political player.

The traditional and formal employment relations (the employer – employee relation, job security and so forth) have been increasingly replaced by other forms of organization of labor relations (the self-employed, temporary or outsourced labor). This same process whereby production relations are made more flexible, in addition to the advent of new technologies, undoes [the up until then] prevailing standards of work relations and ends up

impacting the qualification profile that is now required by the labor market. The net result is a world marked by extreme contrasts, abundance and scarcity, wealth and utter poverty, which end up reinforcing and expanding ethnically motivated regional conflicts.

It is incumbent on teachers to provide guidance to their students and help them understand and evaluate the impact of this series of transformations on their own lives, for even if some of them are not part of the economically active population, each and everyone of them will certainly be in a position to assess the implications of this process within their own family.

Sociology, being engaged in an effort to understand social reality, also provides input to other social players in their efforts to solve problems.

It should be noted that the type of reflection undertaken by sociologists as an interpretation of social reality should not be at the same level of **common sense** understanding, as issues are constructed along explanatory lines, through a specific theoretical and methodological mediation since this is a kind of systematized knowledge of social reality, substantiated in a multi-paradigmatic body of concepts and categories.

- **Competencies and skills to be developed in Sociology, Anthropology and Politics**

**Representation and communication**

- Identifying, analyzing and comparing different discourses about reality: explanations by Social Sciences grounded on various theoretical paradigms and those derived from common sense.
- Producing new discourses about different social realities in the light of observations and reflections.

**Research and comprehension**

- Developing tools for a better understanding of everyday life, by expanding one's "world vision" and "horizon of expectations" in interpersonal relations as well as those with various social groups.
- Developing a more critical view of the cultural industry and the mass media, assessing the ideological role played by marketing activities as a consumer and even voter persuasion strategy.
- Understanding and appreciating the value of cultural manifestations by different ethnic and social segments, by acting in such a way as to preserve one's right to diversity as an esthetic, political and ethical principle capable of overcoming the conflicts and tensions of today's world.

**Social and cultural contextualization**

- Understanding the broad-ranging changes that have taken place in the world of labor and the new qualification profile now required as a result of changes in the economic order.
- Constructing one's social and political identity in such a way as to ensure a fully fledged exercise of citizenship in the context of the Rule of Law, through actions aimed at effectively guaranteeing reciprocal rights and duties between the State and citizens, as well as among different groups.

## 6. Knowledge of Philosophy

For every teacher used to working in Secondary Education, questions such as "What is Philosophy good for?", "Is this course really necessary or is it here just to show this school has more courses than others?", or even "If Philosophy is never referred to in University Entry Examinations, why do we have to study it?" are all too familiar. Questions more often than not raised in the very first contacts students have with this "new reality".

Students usually do not call into question the need or the end purpose of Mathematics or Physics, though very few of them ultimately do choose these courses as professional careers. And it could not be otherwise, since up until recently Brazilian education attached priority – with some variation in the degree of intensity – to knowledge of a technical and scientific nature to the detriment of "humanities" with a view to training students for a labor market of "specialists and technicians", in an "adequate" response to the demand for development and modernization of the industrial and technological world.

Though important to justify students' initial surprise, this is not, however, the only important reason, perhaps not even the most fundamental one. Most people are aware of the reasons that led the authoritarian regime to remove Philosophy from school curricula and, given the countless and excellent accounts available on the matter, it would be pointless to herein try to draw up a complete history of events to date. Actually, if we consider that the inclusion of Philosophy back in the curriculum has taken place gradually for almost two decades, this "new reality" cannot quite be treated as "novelty".

The new Brazilian legislation on education seems to finally acknowledge the historic sense of Philosophy as an activity and, for that reason, it places the emphasis on Philosophy's ability to **systematically** further conditions that are essential for fully fledged citizenship!

However, and despite this ability, it should be noticed that though essential, philosophical knowledge is not enough to attain this end purpose. In fact, stating that all curriculum knowledge contents, courses and components of Basic Education are both necessary and important to develop students' citizenship is almost a pedagogical truism. In that sense, though restoring the rightful role to be played by Philosophy in education, the legislation likewise indicated how to properly scope it for the purposes of Secondary Education: strictly speaking, therefore, the Law refers to knowledge contents in Philosophy **that are necessary to** attain the proposed end. Accordingly, in order to comply with the legal provisions, one should endeavor to sort out, from the vast body of philosophical knowledge available, those contents that must and can be immediately focused on in Secondary Education, which is by no means an easy task.

- **Competencies and skills to be developed in Philosophy**

**Representation and communication**

- Reading philosophical texts in a significant manner.
- Reading, in a philosophical light, texts of different structures and registers.
- Developing in writing the contents assimilated through reflection.
- Discussing, taking stances, defending them with reasonable arguments and changing one´s stance in view of more consistent arguments.

**Research and comprehension**

- Linking philosophical knowledge to different contents and discourse modes in Natural and Human Sciences, the Arts and in other cultural productions.

## 7. Prospects and challenges

Since the knowledge contents in this field have been addressed and more fully described and consolidated herein, attention might now be called to the possibility of developing other knowledge contents in Human Sciences alluded to either implicitly or explicitly, such as Economics, Law and Psychology.

In **Economics**, it is appropriate to expand students´ comprehension and evaluation of the *modus operandi* of a market economy, by reference to production factors, economic agents, institutional aspects, price formation and consumer rights. These clearly indicate the limits of this market economy, as well as the role to be played by the government as a regulatory agent, by providing public services and funding them through taxes and levies, issuing currency and correcting inequalities.

Another set of economic concepts that have been traditionally developed by Geography has to do with the national and international dimensions of the economy, including concepts such as aggregate economic figures, *e.g.*, GDP and GNP, development and underdevelopment, trade balance and the balance of payments, the globalization process as a phenomenon, the different economic systems and international crisis.

In addition to strictly economic concepts, the curriculum might also include references to commercial, fiscal and financial documentation that are important for students to understand everyday transactions in the world of labor and the management of one's personal life, such as an identification of economic players, i.e., individuals and legal corporations; commercial and fiscal documents, such as contracts, stock/ shares, duplicate notes, among others;

financial and banking operations; and the role of interest rates in down payments or payment made in installments.

In addition to references to the political organization and relationships involved in the concepts of State and citizenship as mentioned herein, it is also appropriate to develop certain notions of **Law**, such as an understanding of laws, codes, legal proceedings and international agreements as rules devised to govern life between individuals and States, so as to ensure individual and collective rights and duties. The development of competencies to read and interpret legal documents, the understanding of the concepts expressed therein and a contextualization of legal production is an important element for a thorough exercise of one´s citizenship.

**Psychology**, a science whose historic development attained great significance in the 20th century, has developed a systematized body of knowledge on the basis of concepts and procedures that have had a significant impact on contemporary thinking, particularly in close interaction with Semiology, Linguistics and Anthropology, Sociology, History, Medicine and Education. The production of psychological knowledge contributes to the understanding of the human processes involved in cognitive and affective development, language acquisition, learning, social interaction and the development of one's identity.

In Secondary Education, in addition to understanding the above mentioned aspects, it is important to develop knowledge contents that can explain the processes through which individuals develop their identity in social life, i.e., the emergence of consciousness and an understanding of the mechanisms underlying different forms of behavior.

In developing the identity of young students, knowledge of Psychology can be used to call common sense into question and even contribute to a reflection and better understanding of one's position in the world, by taking the supposedly ahistoric and unique nature of adolescence in a relative perspective, and by undoing a certain degree of determinism as regards social roles to be performed in connection with the school setting, work, sexuality, authority, family relations and the groups with which they interact. The several different social pressures exerted on young people end up breeding uncertainties and imbalances.

Thus, such knowledge may contribute to establish personalities that reflect esthetic, political and ethical values and that ensure sensitivity towards diversity, respect for otherness, autonomy and the development of competencies required for students to act with confidence in adult life.

A reflection about the new directions of learning in this filed of knowledge involves bearing in mind its role in an interdisciplinary curriculum organization, by bringing together different theoretical and methodological benchmark references for the knowledge contents that make

it up, with the object of attaining an integrated vision of the human phenomenon. Societies and cultures must thus be understood in the light of historic, geographical, sociological, anthropological, economic, psychological and philosophical implications, through study projects and activities that prove capable of overcoming the fragmentation of distanced view angles.

As a field *par excellence* marked by contextualizations, knowledge contents in the field should likewise bring about an integration of organized knowledge contents of other fields, inasmuch as it makes it possible to relate them to society and culture. Furthermore, it is through such a contextualization exercise that values and attitudes required to give meaning to languages, sciences and technologies are developed. In the absence of values and attitudes, which are developed by linking up cognitive, social and affective components, these knowledge contents become mechanical and automated, thus devoid of identity and meaning. It is the identity and the meaning of knowledge contents both socially and culturally related that allow us to develop the kind of ethics that provides guidance to thinking and acting on the basis of same knowledge, by resignifying it in a historic project of a humanistic nature. This ethics, which is constantly being reconstructed by individuals and groups, never fails to refer to the ethical constructions of the past, in a joining of traditional and up-to-date values.

In fact, this is what attaches meaning to the resumption and updating of the Western philosophical tradition, as embodied in esthetic, political and ethical principles, reinterpreted from the ancient Greeks, Renaissance humanism and the philosophers of the Enlightenment, and resignified as applied to today's technology societies. The challenges posed by the latter highlight more than ever before the role to be performed by knowledge of Human Sciences and Philosophy in preventing human alienation.

The challenges posed to the field of Human Sciences and Related Technologies include the forms of prejudice to which these studies fall prey, in view of the prevalence of typically positivist attitudes that disregard the value of Philosophy as a school course and mistrust the effectiveness of studies in Human Sciences. There still remains much of the "dis-prestige" that struck this field of knowledge during the recent years of authoritarianism in Brazilian society.

The modern technology society, the more directly observable facets of which change very rapidly, seems not to allow time neither for criticism nor for contemplation and satisfaction with scholarly activity, requiring only knowledge of a more pragmatic nature. However, a humanistic education, capable of facing up to contemporary challenges, cannot afford to dispense with the contribution of Human Sciences and Philosophy to the understanding of the complex social and cultural relationships established following the impact of new technologies. For that reason, professionals in this field of knowledge are called upon to take

part in the construction project for a new Secondary Education in Brazil; one that ensures young people the conditions required for adult life, as adults capable of acting out in several different social contexts. It is incumbent on Human Sciences and Philosophy to cooperate towards a basic education that ensures each and every student the possibility of developing as a thinking and autonomous being, endowed with a social identity related not only to the local dimension of Brazilian society, including its concrete and specific space and time scales, but also to the world dimension.

The commitment to a democratic society and to an expansion of citizenship brings together knowledge contents in this field and a conception of education for freedom that provides autonomy and non-alienation and that is grounded on a humanization of social processes. In that sense, it is the responsibility of this field of knowledge to overcome the adverse effects caused by common sense to a consistent comprehension of the world surrounding us. Influenced by the mass media, knowledge contents in this field have been disseminated in a superficial and distorted manner that may endanger students' intellectual autonomy. It is therefore urgent that we work to liberate man from the present time, by overcoming a notion of history as a chaotic succession of events occurred in the short term and without any connection whatsoever; and likewise liberate man from geographical determinism or from a "geography of platonic contemplation", which breeds the illusion of an endless state of rigidity and inertia that leads individuals to feel doomed to the scarcity or the magnitude of the space surrounding them; avoiding thoughtless and naïve interpretations found in superficial, pedestrian sociological and psychological exercises and in prosaic or commonplace philosophy.

In addition to these external challenges, there remain the field-internal challenges, which involve lingering ideological trends, such as analyses committed to prejudice, nationalism or conservative or left-wing proselytism, which impair both the depth and the effectiveness of any interpretation of social processes. Likewise, lingering epistemological trends embodied in the positivist tradition that fragment perception and preclude an exchange among the several different approaches that would otherwise result in renewed analyses.

Other field-internal challenges are posed by a much observed and criticized overlapping of History and Geography contents in Secondary Education. Such an overlapping stems from a lack of concerted action in course syllabus programming or from an insufficient consistency in recognizing the specific identities of each course.

Finally, the prejudice against Natural Sciences and related technologies, partly the result of the existing tensions in the school and academic community, partly the result of mistrust regarding unchecked and unethical technological progress that threatens life in society. Without losing sight of their peculiar and much needed critical evaluation, Human Sciences and Philosophy cannot, however, yield to a naïve denial of the role of technologies in historic

and social processes to confine themselves in a kind of magical thinking that believes in the possibility of actions and comprehensive changes in the absence of the tools required to that end.

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