

TECHNOLOGICAL EDUCATION IN THE CHILEAN CURRICULUM REFORM

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Introduction:

The incorporation of Technology Education in the Chilean primary and secondary school curriculum responds to the necessity to form persons able to creatively and ethically interact with the processes that characterise present and future technological development and are present in the life of the community and the workplace.

Technological Education thus conceived, is a formation designed to deliver the knowledge and the skills required to participate in society at a given historic moment, and is characterised by continuous development of the domains of action and production. Not to provide it threatens to leave us simply passive, a passivity that excludes us from the development and interchange of new ways to do things in both the national and international context and, in the end, extends the division of equity between people and nations.

In other words, Technological Education represents an effort by the State to encourage and train its citizens to actively participate in society. It is not only an effort to provide adequately trained workers prepared to confront the new conditions of productive organisations, but above all, an effort to provide people with the skills required to participate to the maximum in society, a society characterised by, among other variables, elevated degrees of change, uncertainty, collaborative workplaces, globalisation, preoccupation with the impact of actions, instantaneous communications, an over-offering of information, and changes in social contexts and work. The development of a systematic approach to responsible participation in an artificial world corresponds to creating a basis for change in the culture of the country.

This orientation makes it necessary to show the different roles through which people participate in the technological environment. The roles of user, consumer, designer, and producer constitute relations between people who are continuously creating new forms and opportunities in life. It is an experience that permits students to gain new and different perspectives, and which provides them with an ample vision of the complexities of the technological world and the varied capabilities required for individual action as well as effective and responsible social participation.

Technological Education has as its first goal to awaken students to the technological world as a reality of products created by and for people. It is essential to realise that it is feasible to perfect our surroundings and adjust them according to our necessities by means of our own intervention. This awakening is the first necessary step to move from passive

coexistence with objects and services towards the development of capabilities of intervention in the community in which we live.

This understanding, developed for and focused towards products is made manifest through the knowledge of technical language and is associated with varied forms of effective description and communication necessary for the conception, design, production and offering to users. But this is not sufficient.

The necessary complement to this techno-centric vision is the commitment implied in the technological creative act, which necessarily and inevitably affects people and their environment, occasionally putting their stability at risk.

The latter allows the development of a critical attitude as users and consumers confronted with objects and services, and to establish a responsible perspective as designers and producers with respect to the consequences of the use and consumption of the products. This understanding gives an ethical character to technological acts, a factor normally absent in the technical perspective.

The roles that we have identified allow us a deepen understanding of our participation in the artificial world and to visualise the consequences that are derived from technological acts in diverse dimensions, such as quality of life, the natural and artificial environment, development of the community, and the political, social and economic environment.

It is the necessity to absorb this complexity that shows that the nature of technological action demands co-ordinated action in time and that organisations harness and make this action possible. The relation between people acquires a different look, new roles in a complex world, which are functional to achieving common objectives in the case of the projects, and maintaining viability in the case of the organisations, in order to respond to concrete demands born of personal and social necessities. The abilities and knowledge associated with organisational function allow effective insertion into the marketplace.

The goal of a suitable balance between abilities, reflection about technological acts, aims of technological action and responsibility for the consequences that are derived from it allow mature action in the artificial world.

This is the ultimate goal of introducing of technological education in the national curriculum.

Technological Education

In some countries technological education has a trajectory of approximately twenty years. No consensus has been reached with respect to the correct path to take and it is not a surprise that many studies of the subject are simply taxonomies with respect to different attempts made by different countries.

The Chilean case, which can be denominated second generation, is based on knowledge of a series of proposals and experiences made of other countries.

The following are some of the consensus's that makes a second-generation proposal:

The original curricular proposals are focused toward revealing aspects the technological world, for example craft, design, the workplace and its social organisation, applied sciences, etc.

The consensus is that these different approaches in themselves do not respond to the complexity of the technological experience.

Consequently, technological education must assume that the experience of a person in the technological environment is of many simultaneous and distinct themes that cannot and must not be separated. Doing it so means simply forming a specialist (subject for which other spaces in the education exist, for example, professional technical education).

Another consensus, is the necessity to understand technology as a form of participation in the community, that is, to have influence in the culture of doing. Therefore, it concerns developing abilities as well as knowledge and attitudes that allow one to act responsibly towards people, the economy and the environment from a technological perspective

Although different in its dimension, another consensus is that it is necessary to define, when designing a curriculum, the particular restrictions and conditions of the country, in order to insure the feasibility of implementation. These include economic development of the country, resources available for implementation of the Sector, characteristics of the establishments, characteristics of professors and others.

Study Programs

As well as introducing an obligatory curriculum for technological education in primary and secondary education, the Chilean Ministry of Education of Chile has developed study programs to orient teachers and facilitate their work.

These are specific and detailed with respect to four areas: content (concepts, abilities and attitudes); student learning goals (incorporating knowledge, abilities and attitudes); generative and example of activities for students and teachers; evaluation activities and criteria. All these are presented in sequences and with defined approximate times.

As such, these study programs are models of quality for the educational establishments of the country, in form and foundation. They are useful instruments for teachers in designing suitable and pertinent learning opportunities, oriented towards allowing all students to learn and offering them maximum potential for developing their abilities.

Content

The following briefly outlines the content incorporated into the Chilean technological curriculum for the formation of primary and secondary school students (more details in annex).

Technological education is obligatory during the 10 first years of school and optional in the final two years.

In the first cycle of primary education (first to fourth grades), priority is given to the discovery of the artificial environment and recognition of human intervention in it, the types of activities that are developed in this environment and associated professions

This includes observing simple objects, understanding for what they serve (functions) and their characteristics, as well as the construction of simple objects considering adequate handling of materials and tools, and as possible the reuse of materials. In this context, focus is on the importance of planning tasks and organisation of resources. It is important to mention that from grade one, the students begin progressively to integrate technological processes with respect to the designing, planning, producing and communicating about products.

The progression of activities of fifth and sixth grades is based on the development of three subjects: the relation between object and society treated from the perspective of the evolution and use of the technological objects; the analysis of functions and characteristics of such; and the care, maintenance and repair of a technological object.

In fifth and sixth grades, the study programs are structured in three units: historical evolution and social impact of a technological object; analysis of an object; and maintenance of objects, in 5th grade, and 6th grade, analysis of technological objects as services; technological systems as an association of components; and repair of simple objects.

The program of seventh grade introduces the students to subjects associated with the changes that human technology produces in the environment when modifying and using the resources that the planet offers in the production of different products.

In eighth grade, the program offers activities for the analysis and understanding of subjects related to the use of technology in different productive processes; knowledge that objects are composed of physical systems and subsystems that make their operation possible; the use of technical language to interpret and to produce representations of the object; and the use of this knowledge in the construction of an object.

In the ninth and tenth grades, the program is based on a practical project, reflection about the processes involved and the acquisition of related content (abilities, attitudes and concepts). Through the realisation of projects, the program offers opportunities to the students to plan, execute and evaluate activities that suitably represent the four phases in

the life of a service: requirements analysis; design; production and development; communication and impact analysis.

The progression is based the development of the product project: in ninth grade the students work at all stages of processing a technological object, and in tenth grade, a service, and the development of concepts that sustain quality control. During the development of the project, the students learn basic concepts of project organisation and administration. In addition, the tenth grade program includes a summary of learning that they have progressively and systematically been working on since first grade.

The program for eleventh or twelfth grade is directed towards insertion in the workplace, providing the students with a systematic vision of productive organisations. Their relations with other organisations and the environment are analysed as well as their internal operations. Basic management tools are also given to the students.

It is hoped that by means of ten years of obligatory technological education the students will have the opportunity to develop abilities, attitudes and knowledge that facilitate their understanding of a world characterised by the technological interactions that affect their lives. Knowledge that is not only crucial in integrating people into society as intelligent, self sufficient actors in a state of permanent learning, within the framework of constant economic, social and political change, resulting of the globalisation and acceleration of technological changes, but that also facilitates their contact with the work experience.

Implementation process requirements

As anticipated, a series of requirements have arisen in implementing this sector that require immediate solutions and can be equally applied the educational system as a whole.

1. First, training the teacher trainers is required. Given the novelty of technological education, it is necessary to design a special offering for teachers and to accompany it with a system of permanent practical support. Above all, this training must include reflective and practical opportunities.
2. Support materials. The study programs, although they provide direction, are insufficient. Teachers need a wide variety of support materials: that aid in orienting the proposed program activities; that provide variety of examples in support of the activities; that contribute project models; that provide direction and evaluation examples.
3. Initial formation. It is indispensable to be able to count on an offering for the formation of educators in this sector.
4. Support networks. Educators have spontaneously created support networks in order to resolve the challenges imposed by the sector. It is necessary to design a formal strategy of support and backup. Very few of these networks are using the internet as support to share experiences and materials.

5. Community sensitivity. It is necessary that parents, politicians and industrialists familiarise themselves with this sector, its objectives and its demands. In particular, this curricular sector requires a high degree of participation by the community. Certain important advances have been made in this area, in particular, through the commitment of the “Fundación Telefónica” to provide free dedicated access to the Internet to all public and private schools in Chile. To date approximately five thousand schools have been connected. In addition, through projects such as Enlaces computers have been placed in 5.248 educational establishments with additional training and permanent assistance to use it as a support for pedagogic innovation, with a plan to cover all schools by the 2006. Nevertheless there is much that remains to be done given that, with respect to computers, most teachers are functionally illiterate and the number of computers available to students is woefully inadequate.

6. Communication with the management of educational establishments. It is necessary that they are aware of the practical changes and demands presupposed by the sector in order to facilitate its management .

The teaching staff

All educational establishments of the country (approximately 10 thousands) are implementing technology education from 1st up to 10th grade resulting in the necessity to provide approximately sixteen thousand teachers.

The country does not have teachers with a suitable specific formation in the subject matter at the moment. Two different studies, one of 145 primary teachers and another of 98 secondary teachers across the country, reveals that the teachers who have assumed responsibility for technology education come from a variety of disciplines: in decreasing order: crafts, technical professional specialities and natural science, as well as social science, mathematics, languages and physical education.

They have become involved principally because school administrators have given them no other choice. A very small number have a genuine interest in technological education.

The Ministry of Education is offering an in-service teacher training programme for the teachers who are assuming responsibility for the area. Although insufficient, the coverage cannot be extended, since the Universities currently do not have an offering that responds to the necessary exigencies. The Ministry has made two calls for the teacher training. In the first call only 20% of the proposals submitted from Universities were admitted, in the second only 30%.

Faced with this reality it is essential that universities take a predominant role in the in service and initial teacher training, but in order to do so they must first develop an internal capacity to assume the task.

The offering that emanates from the Universities and other institutes must respond to the distinct necessities of the sixteen thousand teachers that are currently charged with implementing technological education, taking into to consideration the diversity of their formation as well as providing for teachers who wish to specialise in technological education as a career.

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Annexed

Units of content in the study programs from 5th to 11th grade.

5th Grade

<p>Historical evolution and social impact of a technological object</p>	<p>Analysis of a technological object</p>	<p>Maintenance of technological objects of different materials and terminations (metal, wood, textile, plastic, ceramics / clay)</p>
<p>Historical evolution of an object establishing the different stages through which it has passed: how it was, of what materials it was made, how it was used, comparisons with present objects.</p> <p>The effect that the existence of the object has had in the life of people.</p> <p>Detection of a problem related to the object and proposal of innovation or improvement.</p>	<p>Analysis of the object: what it is, who uses it, why it is used.</p> <p>Description of functions.</p> <p>Evaluation of the product: does it meet a need?, is it efficient?; is it safe?; is it easy to use?; is it easy to maintain and/or clean?.</p> <p>Specification of the material of which it is made: how this affects its appearance, security and durability.</p> <p>Differences between the selected product and other similar products in the market: quality; efficiency; design; ease of use; price.</p> <p>Destination of the product completing its useful life; to what extent this affects people and the environment;</p> <p>Presentation of the product in the market; relation between the quality of the object and what is published about it</p>	<p>Basic characteristics of the materials that make up the object (hardness, texture, resistance, etc.);</p> <p>Investigation about wear and tear on the object in daily;</p> <p>Investigation and description of the characteristics of the materials and tools that are used for cleaning and maintenance;</p> <p>Cleaning and maintenance of the object;</p> <p>Description of design problems with respect to cleaning and maintenance;</p> <p>Design proposals of the object that facilitate its cleaning and maintenance.</p>

6th Grade

Technological objects in the context of a service	Technological systems as an association of components	Repairing simple objects
<p>Analysis of the selected service: what it is; who uses it; why it is used (what function it fulfils).</p> <p>Description of the technological objects present in the selected service: what are they are; why are they useful; how can users and workers benefit from them.</p> <p>Functional description of the personnel who work within the service area: description of what they do; identification of the job or profession.</p> <p>Detection of problems within the service and proposal of innovation or improvement.</p>	<p>Identification of the presence of certain technological principles in the object.</p> <p>Decomposition of the object: identification and graphical representation of the parts; how the parts are articulated; function of the parts; identification of the materials.</p> <p>Processing an instruction manual for use and a maintenance of the object.</p>	<p>Analysis of a object to be repair.</p> <p>Analysis of how the parts are related.</p> <p>Characteristics of the materials that compose the object (resistance, flexibility, hardness, texture).</p> <p>Analysis of the flaws and determination of the appropriate repair actions.</p> <p>How the object is worked the object work according to its characteristics.</p> <p>Determination of the materials and tools used for repairing the object.</p> <p>Knowledge of techniques.</p> <p>Planning and executing the repair.</p>

7th Grade

Relations between the technological product and the environment.	Use and advantage of conventional and alternative energies and efficient use of materials	Applications of alternative energy sources and recovery of materials in the production of a technological object.
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<p>Investigation of the environmental impact of the use of resources in processing a technological product.</p> <ul style="list-style-type: none"> • Analysis of the composition of the product, to determine the resources used in its manufacture or production (material and energy used for its transformations); • Investigation about places and forms of obtaining the resources used for its production or processing; • Investigation about general applied to the resources to produce or to process the components of the product; • Investigation about alterations made to environment by the studied processes and currently used measured to reduce environmental impact. <p>Elaboration and simulation of suggestions directed towards reducing the environmental impact caused by transformation processes and treatment of wastes of the resources used in the production or processing of the product.</p> <p>Elaboration of suggestions to reduce the environmental impact caused by the extraction of natural resources.</p>	<p>Distinction between conventional, non-conventional and secondary energy sources.</p> <p>Investigation about the characteristics of diverse power sources:</p> <ul style="list-style-type: none"> • Conventional: Petroleum and derivatives, Firewood, Mineral Coal, Natural Gas, Nuclear Energy and Hydroelectric Resources • Non-conventional: Solar energy, Aeolic, Geothermal Energy, Seewaves, Animal Traction, Biomass. <p>Investigation about the domestic use of conventional and non-conventional energy sources used to illuminate, move, heat, communicate to us and to cook.</p> <p>Analysis of the concept of domestic power efficiency. Analysis of well-known systems that use non-conventional and make an efficient use of energy.</p> <p>Investigation and experimentation about: recycling, recovery, reusability and reassignment as examples of the efficient use of the materials.</p> <p>Determination of a simple object to build, related to the use of a non-conventional or energy efficient source; specification of the functions and useful characteristics that it must fulfil the object: determination of who will use it, why; how and where.</p>	<p>Design of the object:</p> <ul style="list-style-type: none"> • designing technical specifications based on the functions and characteristics of use: form, materials, structure; • investigation of the possibilities for recovering waste materials rejected and their reassignment or reusability in the production of an object; • study of the properties of recycling waste materials generated in the production an object; • simple graphical representation of the technological solution; • knowledge of techniques, use of materials and tools used in the preparation of the object, planning of construction process. <p>Building the object:</p> <ul style="list-style-type: none"> • selection of tools and materials to use; • organisation of the work considering available human, temporary, power and material resources; • pertinent, effective and safe use of tools and materials so that the elaborated object fulfils the technical specifications; • use of technical language; • execution of the work in healthy and secure conditions; • quality control while working; revision of relations within the work group; • design of a commercial or educational strategy to bring the product to end users.
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8th grade

Mechanisms and circuits	Productive processes	Technological development and new activities
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<p>Analysis and experimentation with mechanisms and basic circuits in mechanical, electrical, electronic, hydraulic or pneumatic applications: identification of the functions they fulfil.</p> <p>Identification of basic operating conditions; action of mechanisms or circuits; diagramming the representative operation of a simple technological object.</p> <p>Analysis and construction of basic mechanisms or circuits: systematic analysis of a mechanism or circuit; diagramming the construction of a mechanism or circuit using technical language; planning the tasks for the construction of a prototype; selection of materials and tools and determination of costs; construction of a mechanism or circuit.</p> <p>Innovate the functions of technological objects through the incorporation or modification of mechanisms or circuits.</p> <p>Elaborating a communicational object to display a technological innovation and to explain its use.</p>	<p>Systematic analysis of a productive activity: analysis of a productive activity as a process; entrance identification of input, output and transformations; diagramming the process.</p> <p>Analysis of a technological object as a process: identification of input, output and transformations.</p> <p>Experimental analysis of the transformation of materials and energy: identification of the input materials and output product, and the operations realised with the input materials to obtain the output product; design of a technological process for energy conversion.</p> <p>Analysis, design and construction of mechanisms and circuits of control.</p>	<p>Identification of technologies (nanotechnology, biotechnology, robotics and automation) and impact analysis.</p> <p>Analysis of a technological application for a specific end: social impact, technical functionality.</p> <p>Investigation on and experimentation with services of the Internet: chat, electronic mail, of information search of information, lists of interests, www, newsgroups ...).</p> <p>Analysis of the impact of Internet use.</p>
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9th Grade

Determination of a technological object to construct	Determination of the user requirements	Design	Production	Distribution
<p>Determination of a technological object in order to elaborate a practical project.</p>	<p>Specification of the characteristics of usage that the technological object must fulfil so that it responds to the necessities of the users.</p>	<p>Definition of the characteristics and functions that it must fulfil and analysis the information obtained.</p> <p>Study of a range of similar products in the market.</p> <p>Determination of possible solutions and their technical specifications</p> <p>Selection and justification of one of the alternatives, according to restrictions and established criteria.</p>	<p>Planning the different production operations.</p> <p>Materials and components within the context of the project.</p> <p>Production according to the plan.</p>	<p>Design and elaboration of product presentation and packaging.</p> <p>Elaboration of end user documentation and information.</p> <p>Product registry procedures.</p>

10th Grade

Selection and Design of the Service	Planning and Development of the service	Behaviour of the service in the environment
<p>Collection and analysis of information about the problem, the users and the resources available.</p> <p>Analysis and comparative analysis of solutions.</p> <p>Design of possible solutions and their technical specifications.</p> <p>Selection and justification of an alternative.</p>	<p>Planning the service</p> <p>Communication and promotion of the service.</p> <p>Co-ordination of means and people.</p> <p>Equipment and infrastructure within the context of the service.</p> <p>Execution of the service and mechanisms to support adequate operation.</p> <p>Optimisation of the service by follow-through, feedback and adaptation.</p>	<p>Identification of the relationships between the service and other systems that make up the environment.</p> <p>Identification of influences of media on the service, and of the service on the media.</p> <p>Adaptation to the change.</p> <p>Distinction between users and suppliers.</p>

11th or 12th Grade

Analysis of Organisations and their Environment	Selection and description of an Organisation of people	Labor insertion
<p>Definition of organisation as a system.</p> <p>Identification of areas of activity in which an organisation develops</p> <p>Relationship of an organisation and the environment in which it operates.</p> <p>Relation of the organisation with competitors, clients, suppliers, employees.</p> <p>Opportunities of, and threats to, an organisation.</p> <p>Identification of different types of organisations.</p> <p>Comparison between different organisations. Similarities and differences between: public and private organisations; small, medium and large organisations; productive and service organisations; organisations with distinct roles or functions.</p>	<p>Identification and description of organisational structures.? relations of authority? roles? organisation charts</p> <p>Layout and structure of an organisation.</p> <p>Analysis of the concept of culture and climate, related to organisations.</p> <p>Analysis of the executive of organisations: motivation, leadership and communication.</p> <p>Identification of the human resource policies of an Organisation; Requirements, recruitment and positioning of personnel; promotion; Personnel evaluation; compensation and qualifications.</p> <p>6, Identification of the security policies of an organisation.</p>	<p>Searching for and identifying alternatives of work for young people</p> <p>Description of the job postulation and selection.</p> <p>Description of the process of hiring of new employees.</p> <p>Description of the process of introducing new employees to the organisation.</p> <p>Handling of commercial documentation (invoices, promissory notes, receipts, instruments of credit, loan applications).</p> <p>Knowledge and management of banking elements: procedure of opening and closing savings accounts, current accounts, knowledge of the emission of documents (checks, deposits, etc.), savings systems, collection, interest and the usual forms of calculating it.</p>

