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Technological development and teacher education curriculum in Spain

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Abstract

The purpose of this article is to present questions and reflections to justify a proposal for technological contents to be included in a **teacher education** curriculum. **Technological development** is the central topic of subject matters, because technological development at any given time is really the memory of all the roads taken by technology through recent centuries up to the present. Specifically, **three** thematic points must be included: the **economic-labour**, **political** and **cultural dimensions** of the development of new computer products. These three groups of subject matters are historically justified because they have antecedents and because their inclusion in mandatory university courses responds, in part, to the need to compensate for the social and labour imbalance created with the expropriation of the artisan's knowledge in past centuries.

1. Introduction

> *"...The goal which we now face is that of knowing how to take advantage of these technological changes in favour of all of humanity, and to use these new instruments that research and discovery have put into our reach so that we can construct a more just and solidary society—more informed, and as such, more free—able to promote ethical and moral values and to definitively push aside the shadows of individualism and egoism that hover over the computerized world which is soon to come.".*

(Fragment from a speech delivered by King Juan Carlos I of Spain at the Tenth World Congress of Computer Technologies.)

One of the most decisive and important moments in the design of a curriculum is the selection of contents or cultural elements that should be experienced and learned by specific sectors of a population through educational institutions. The main thrust of this article is to present questions, doubts, and reflections that help to justify a proposal of

technological subject matters that might be valuable in both this time of educational reforms and in subsequent revisions of such reforms.

The rewriting of syllabi for degrees in Teaching, Pedagogy, and related fields, begun in 1992 in Spain and rethought later at different times— in 1996, for example—, has added a series of disciplines that attempt to summarize and represent the present state of science and technology. It is understood that a clear knowledge of these topics is necessary not only for life today, but also in answering the different social and professional demands that have arisen in developed nations.

Some of the new basic subjects (which are mandatory in all of Spain), like "Educational Technology" and "New Technologies Applied to Education", were created to make room for the analysis of the development acquired through the use of technology and to study the practical possibilities that each technology has in different social environments. This means that, since the implantation of new study plans, the possibility and responsibility exist to select, from among all of the meanings and functions related to computer and communication technologies, the ones to be incorporated as topics for these subjects and the ones to be left out. However, from this very moment, it is necessary to consider and reconsider some concrete goals and to progressively define the subject matter of these disciplines, above all, because their content descriptions contained in official documents, despite being brief, are excessively general. For example, the Official Gazette (Boletín Oficial del Estado (BOE)) of 11-5-1993, states on page 31,291 that the contents of the subject "Educational Technology" forming part of the University Degree in Pedagogy shall deal with "technological change and pedagogical innovation". The very same document (BOE from 1-19-96, page 16) indicates that the subject matter for "New Technologies Applied to Education", belonging to the Teaching and Social Education degrees, will involve the "use of the principal computer and audiovisual tools". It is obvious then, that these thematic guidelines, directly from the Ministry of Education, are too extensive and vague—a supposition which leads one to feel the necessity to fill up these broad recommendations with substantial content.

Certainly, in order to decide what materials should be introduced in these subjects, it is necessary to begin with a clear *understanding* of technology. At the same time, these materials or subject matters have to be related to the implicit meaning of such an understanding. For this reason, there must be a clear understanding of what is meant by *technology*.

1.1 Understanding Technology

A review of the history of machines and devices reveals that the *prelude* to contemporary technology was actually technique or method, that is, a plan of action carried out with tools. Work traditionally belonged to the artisan who possessed the necessary knowledge, tools and skills to develop and apply his methods.

One of technologies' *dramatic climaxes* began slowly at the end of the sixteenth century and ended in the middle of the eighteenth. It can be observed that in this period the use of technology led to economic and political consequences. On the one hand, economic positions and interests demonstrated a pursuit for profitability and power, whereas on

the other, political points of view sought to obtain control and manageability over sectors of the population.

Most of the knowledge derived from technologies was applied to industry and contributed to the hierarchization of such activities as design, planning and execution (the vertical plane). This had the effect of differentiating intellectual work from manual labour and implied a social division based on this separation in the working world. Within each of these levels, there was also a fragmentation or a division of labour activities in the horizontal plane, thanks to the organization of work based on production lines, helping, in part, to shape the flexibility, the dynamics and the globalisation that characterize developed societies in the post-modern era.

Technology was defined as a plan of action that was executed with the help of labourers, machines and tools, etc., for the purpose of transforming the surrounding environment and obtaining profit. This conceptual explanation, however, failed to pay attention to conflicts, interests and other ups and downs in the history of each technology. Technology was shaped, in part, by historical knowledge that the artisan initially possessed, but which was eventually taken from him.

The *outcome* of this brief history, from the point of view of this understanding of technology, thus leads to fusing the knowledge and information that rightfully pertain to each individual technology with the technology itself. Only in this way—through technology—can we properly understand how the technological bases of work were severed centuries ago.

To link a clear understanding of technology with technology itself will be a slow and complex process. At the same time, one of the ways to specify such a procedure, and thus make it possible, is to present technology not only through its products and tools—as if we were dealing with a case of metonym— or as a plan of action lacking any justification, but rather as being united with the very knowledge that establishes it and explains its conflicts, ups and downs, motivations and interests that are actually responsible for its origins and problematic development.

It is possible that this idea, presented here as an outcome, is merely a dream that tries to help diminish basic inequalities that exist between sectors of the population, but as Manuel Rivas said in an interview by X. Hermida (1998) in the newspaper *El País* about his novel *The Carpenter's Pencil* (in the article, a pencil is considered a technological product):

> "Dreams also form part of reality. I'm very interested in the idea of imagination by necessity. Invention as an answer to the necessity to defeat pain, to ward off evil. It's like an artisan's imagination that comes from below. All people and all objects wish to tell a story, sometimes desperately" (p. 4).

It is precisely the story of each individual technological product—it's *history* if you will—that can and should give meaning to technology as a whole. In the same way that Manuel Rivas was able to revolutionize the vision of many readers using a carpenter's pencil, it is also possible to reinvent the word *technology* in order to transform the meaning that it has acquired in recent times as a means to free ourselves from prejudices, so that we can contemplate more clearly the strings and mechanisms that

govern our lives. This is a job that must begin in schools, and for that reason, it is necessary to train teachers whose mission it will be to reflect on technological subject matters. Of all the possibilities, the most important are those technological topics that best summarize the transformations and the different paths that technology has followed in its development. Thus it is important to consider and adopt a position with respect to what teachers should know about technology and its development, which technological products should be taught in conjunction with their history, and how this technological knowledge should be used in order to achieve the three goals proposed by the King Juan Carlos I of Spain, that is: to favour the development of all humanity; to construct a better society; and to eliminate the most general, worldwide problems many women and men are forced to endure.

These are questions whose answers are going to determine the central points of subject matters related to the technology and new technologies that will included in the syllabus for the training of Teachers, Pedagogues, Social Educators, etc. In order to respond to these relevant questions, it is necessary to approach the two different dimensions of the issue. The first refers to the technological products selected. The other is related to the elements or historical variables of each individual technology that will be highlighted and given priority. The fact is that the itineraries followed by each technology are so complex and so tumultuous that such an immense amount of material would not fit nor could possibly be taught in the course of a normal academic year.

In the first place, the technological products selected and the duration of an academic course affect the number of products chosen and which subject matters are given priority over others. Accordingly, multimedia computer systems and telecommunication networks seem to be the most adequate machines and tools because both thematic groups, technology and its historical variables, converge in audiovisual and computer mediums. There are several reasons that support this choice (Davis, 2000; Cornu, 2001; etc.) but among the most obvious are the very title of the subject, "New Technologies", and the conditions and social impact that current communication and computer technologies are creating.

In the second place, considering the technological subject matters that are to be included in the training of teachers, an analysis has been done of what information best explains the changes, the tensions, and the interests that made each one possible. This is a knowledge that must be restored to the artisans of teaching that, in addition to providing a clear understanding of the mechanisms that frame our lives, will also help to educate sectors of the population with a sensitivity that inspires the construction of a more just society, with less inequality and more respect towards the environment. For reasons touched on previously and which will be explained in more detail in the following sections of this article, it can be held that all technologies have experienced their own histories which, without a doubt, have always been linked to the idea of development. Thus, **technological development** is understood as the central topic of subject matters to be taught about current computer and communication technologies, precisely because the path taken by any one technology has always been preceded by a group of human beings who have made certain decisions and who have applied certain strategies and plans of action that, because of human nature, have not been free of personal intentions and ideologies. This development has also preceded and been present in computer products (multimedia systems and computer networks), as indicated above, because technological development at any one time is really the memory of the roads taken by

technologies from the last centuries up to the present. Taking into account this reflection, technological development is arguably the conceptual element that best puts us on the road back to the restoration of the artisan's technological knowledge. In this sense, technological development is possibly a way to re-establish communication with the very fundamentals of work (which include teachers).

For all of these reasons, it is clearly necessary to include these subject matters in the syllabus for the training of teachers because in order to understand a tool, one must first know the reasons and intentions that inspired the technology and set it on a given developmental path. Above all, however, once such motivations have been revealed, it is necessary to include these topics in order to study what each one of them can and cannot do in diverse educational environments as remedies for inequality, injustice and other miseries that tend to diminish the quality of life of wide sectors of the population.

2. Technological development: A central topic for the subjects "Educational Technology" and "New Technologies applied to Education".

As commented earlier, the title of this section is one of the concepts that best summarizes and reflects the transformations that current technologies share and have experienced since the fifteenth and sixteenth centuries. Naturally, these changes embody the causes, conflicts, interests, and conceptions of the world that moulded the knowledge that belongs to each individual technology.

The relevant meaning and the central position that technological development maintains in the previous proposal on subject matters justify analysing a bit more extensively two dimensions of this issue, which future teachers will have deal with. One of them deals with the very nature of this development, while the other considers two layouts or models of development that are now taking shape.

2.1 Some Reflections on Technological Development.

The existence of diverse meanings related to technological development obliges proposing a brief summary in which different points of view can be brought together from two perspectives: a quantitative, or economic, position and qualitative position.

From an economic point of view, technological development establishes the exact path technology takes when striving for profitability, investment benefits and efficiency in market development. From this perspective, technological development and progress are united because technology adopts the finality of contributing to the growth of economic markets. This idea of technological development is similar to an economic myth of transformation and change whose movements are independent of human action. This is a good strategy to present a specific vision of the world simultaneously with a mental conformism because, in this sense, we can speak about economic technological development as constituting a group of subject matters that here will be called, "Technological Bases of Thought". These bases are understood to be a part of social strategies established by power structures whose goal is to submit *thinking* to the mental

structures of social conformism, that is, to direct people's thinking towards the interests of power.

From the second perspective, technological development is seen as the road followed by technology when searching for some kind of evolution of humanity toward equality between sectors of the population and between peoples while respecting the environment. If there is something both perspectives have in common, it is that they are both past and present sources of socio-cultural controversies.

For example, a provocative topic that has led to much controversy is related to the dependence and control that those who acquire technology tend to experience. This is a polemical issue precisely because the idea of modernization through the acquisition of technology carries with it the unnoticed implicit assumption of cultural values that, by way of technique or method, transmit ideas and conceptions of humanity and of society without the existence of "persuasive subjects". In reality, however, these very "subjects" do not exist precisely because there is a conscious desire in the acquisition of devices to satisfy some functional needs, and also, because of the absence of any kind of imposition.

These considerations call for a series of questions that lead us to take into account new controversial issues that must be dealt with in the training of teachers. One group of questions is centred on the variables and driving elements that control the development of tools in a certain direction. That is to say, how can we decide and what principles and models must we select in order to determine the path that is to be followed in technological development and innovation? The second question is an attempt to analyse what it is that tools and machines possess to be able to transmit ideological postures in an unnoticed way. Specifically, how does technology become impregnated with certain ideological values and meanings that tend to infect those who use it? Finally, how does technology come to favour certain forms of perception, reasoning, analysis, etc., over other cultural forms of knowing?

Discovering what lies beneath these questions or what direction is to be taken by new technologies supposes the analysis of principles and models of innovation and development combining different elements and dimensions which contributed to the very origins of these same technologies. What developmental models provide orientation on the path that technology is to follow? Who is interested in introducing new technologies (NTs) in schools? These are relevant and vital questions for future teachers, and for this reason, must be included as subject matters in their initial training or in their subsequent professional refinement.

2.2 Technological Development Models

Reviewing and analysing the principles and theories that explain the changes and determine the paths followed in the development of technological devices, two positions can be distinguished: the technical or technological and the practical or situational.

With respect to the first, I think that a basic idea or principle that needs to be pointed out is the fact that the nucleus of all change and innovation can be found in two human roles: first there is the expert, and later, there are those who are situated in production environments and who need to contract the expertise of the first. For example, if we

analyse the environments where a predominance of investments exists in innovation and technological development in Spain, we find that what stands out is social labour (communication technologies that combine computers and lasers to manage large department stores, compression machines and time-saving devices like microwaves and high velocity trains that free up more time for men and women so that they can, among other things, spend money). This same innovative nucleus can also be located in two myths: the first being the presentation of technology as neutral, and the second, technological determinism. It is necessary to underline just how this idea, characteristic of the technical position on development, is rooted in the seventeenth and eighteenth centuries when the separations between knowledge and action, theory and practical know-how and intellectual and manual labour occurred.

The decentralization of decision making about directions to adopt appears as one of the basic principles with respect to the second dimension of technological development—the practical or situational-, where a direct or indirect participation exists on behalf of all of those affected by the application of technological products (Youngs, 1999, 2001). This understanding technological culture incorporates democratic participation into the selection of alternatives related to technological development and application by peoples who, directly or indirectly, receive their effects. This other form of considering the means—their development and application—will permit the protection of minorities and disadvantaged ethnic groups because public debates and opinion will inevitably manifest the lifestyles and standards of social behaviour that are going to be created. At the same time, they will show just how this new technology will influence the relations between peoples and how these peoples interact with their natural habitats. The different national or international organizations, then, articulate thematic debates and control the decisions to be taken (Quintanilla, 1992).

With regard to these two positions, products of theorizing about the direction technological development is to take, the first group of thematic content for the subjects "Educational Technology" and "New Technologies Applied to Education" is understood to necessarily include the analysis of the factors which govern such a change with regard to democratic participation. This knowledge must lead to principles that orientate the innovation and application of technology in an equal way, blocking the growth of inequality between nations and respecting ethnic groups and unprotected peoples. This consequence, distinguished from technological development between peoples, leads me to believe that many devices created are not compatible with just any way of life, any value system, any form of social organization or any system of production. This idea reasserts the argument that technological development is biased because it is carried out by those who possess it, understand it and control it. It can be argued that this means that one of the topics that must be included in the syllabi on technology is the idea that underdeveloped nations lacking control of their resources cannot develop autonomously their own tools, that is, the devices they need for their own well-being.

Before continuing it has thus been important to present the elemental dimensions that characterize both basic strategies of orientation and management with regard to the direction to be taken by technology. To a certain degree, technology itself unites the milestones that marked the evolution of the conceptions about it pointed out in the previous section. At least three thematic points can be made on the subjects dealing with technology and new technologies that form part of the degrees in education offered in

Spain. There are **three** groups of subject matters that are historically justified because they have antecedents and because their inclusion in mandatory university courses responds, as I showed earlier, to the consequences and transcendence they have had on technological development up to the present moment (Desforges, 2001). The three areas of subject matters are:

-Subject matters related to the **economic and labour** dimension of technology, historically justified, among other reasons, by what was understood as technique, or knowledge and skills that the artisan possessed, making possible the use of tools and machines in the work environment. Today's teachers (above all in compulsory education) must be considered artisans and need to recover the knowledge traditionally characteristic of the profession that converted them in protagonists in the labour world.

Within this category, the following subject matters should be included in the curriculum on technology designed to train future educators. First of all, one of the primary applications of technology is the development of economic markets; that is, computer and communication technologies stem from and are developed to make patent the globalisation of economic transactions that exist between markets. This is done by transmitting information quickly. Castells (2000) coined the phrase "society network" to express the idea that world economies maintain a high interdependence not only among themselves, but also, among nations and among the societies where they are located. Another example of this function, illustrative of the direction taken by current technologies, is the dynamic energy they have incorporated into the workings of large department stores. Concretely, the result of mixing laser and computer technologies allows for a previously unheard of speed and efficiency in the exchange of products, preventing the formation of long lines at the cashier (later on, it will pointed out that now, more than ever, in this post-modern society, "time is money"). And finally, other examples that manifest this function of new technologies can be found in audiovisual communication used by publicity agencies interested in the promotion of spending, and also, in the flexibility of organization and management that companies are acquiring to become more competitive and profitable.

-Topics related to the **political dimension** of technological development whose historical reference is concerned with the justification of the previously mentioned economic dimension.

Correlated to this political dimension are the consequences that this aspect of technological development is having on the control and manageability achieved through technology.

Another idea related to the previous one is concerned with the role the different national governments have to favour the settling of markets within their territories. As seen earlier, basic knowledge created in fields like Computer Science, Data Communications, Robotics, etc., is being applied to develop new systems and tools among whose principal goals can be found encouraging market placement and the perpetuation of markets in countries that already possess them. Among the different applications suggested by these technologies, at least implicitly, those that develop the idea of a *unified thinking* will be addressed. A part of this idea's "decalog" are the requirements that countries must meet in order for markets to establish themselves within their borders.

-Contents derived from the **cultural implication** of development due to technology.

This is a response to the two previous groups and is historically based on the separation of intellectual and manual labour that has led to a growing increase of knowledge directed at, among other things, the continuous modification of labour organization in order to obtain more profit per capital. The changes in organization took into account new relationships between spaces and times as well as different ways of perceiving and feeling both dimensions.

In this regard, one of the "potentials" that some teaching criteria assign to NTs and that is used to justify their incorporation in teaching syllabi is how it opens up the possibility of shortening training procedures in hopes of achieving better time management. The importance that is given to this reduction or freeing-up of time has reached such a level that it is considered to be a quality control reference for technological materials and systems. That is, the faster a topic is presented—either a historical event or succession of events—the better it is evaluated by the publishing market and the more useful it is considered by some members of the teaching staff. This usefulness is understood from two inter-related points of view: as a substitute for teachers in the design and creation of materials and as a way to prevent the making and development of conceptual outlines or guides that are to be saved on the software and reproduced by the different technological systems. This function assigned to new technologies supports the values defended by the idea of *unified thinking* because it compresses the teaching procedure so that teachers can instruct and impart information about more subject matters than those that have already been selected and packaged in such materials.

It is doubtful this timesaving function of technological systems and their corresponding software is in our best interest, above all, because more than just instructing, we want to educate. This idea of educating is best characterized by putting into action slow, but in depth procedures, where the most important thing is not necessarily time management, but rather, the very nature of the experiences we live. In this sense, Wenger (1998), Hung and Chen (2001), among others, think that schools should become “communities in practice”.

The previous groups of thematic content that have emerged from this conceptual analysis of technological development must form the basis of subjects dealing with "new technologies applied to education", because, more than being rooted in history, they share clear implications and a current relevancy. The next section seeks to justify this idea.

3. The National Information and Educational Communication Centre (CNICE) of Spain.

The objective of this Centre is the training of educators for the successful use of Information and Communication Technologies (ICTs), or *technological literacy.* The CNICE, through its Training Server (http://www.cnice.mecd.es), offers a flexible training method with the following characteristics:

- Respect for the learning pace of the user.

- Monitoring of the individual achievements through tele-tutoring.
- A teacher can set up his/her individual training plan according to his/her own professional and personal interests.
- Permanent access to resources and tutoring (whenever equipment with communication options are available).

On the other hand, the flexibility of both the students' (teachers in this case) and the tutors' work are compatible. They can schedule the fulfilment of their respective task from home at a time that does not interfere with other activities. If necessary, they can get in contact on a daily basis, without time or space barriers. User-teacher must have access to Internet. If they do not, they may get access through the CNICE´s Server Centre. Once they enrol in a course, they will be provided with the specific tools required for the course.

Each training course has a certain number of students living at various locations. The total number of enrolled (15.000 teachers of Primary and Secondary Education in 2001) is divided into groups assigned to the different tutors responsible for the course. The CNICE assigns different numbers of students to each tutor, according to the degree of difficulty of the course and the availability of the tutor. The objective and contents of these courses involve the *technological literacy* of teachers.

Technological literacy is understood to be the preparation that is needed to equip teachers to access and capture information and messages transported over the tools resulting from the development of information and communication technologies, in addition to the capacity to generate them using such tools. In this sense, technological literacy constitutes a resource that equips teachers to handle a range of information and messages from different sources and with differing degrees of accuracy and logic. In order that this technological literacy result in the effective use of the products of technological development, a twin perspective that covers both *instructive* and *formative aspects* must be taken into account.

The *instructive aspects* include that the basic preparation of teachers so that they can acquire basic skills of an instrumental type that allow them to make efficient use of these tools in teaching situations: organizing and drafting information, accessing and locating data and documents, reading and creating audiovisual messages, exchanging information, establishing communications, and processing and publishing information.

In their *formative aspects,* the educational/training needs of teachers must be met. The teaching profession, as the cornerstone of the teaching and learning processes, requires training with twin objectives: professional incorporation into the society of technologies and the multiplier effect on the teaching of students by incorporating these tools in the teaching and learning processes with a view to their improvement. The present globalisation process is forcing institutions and companies to form alliances, or even break them in some cases, in order to achieve critical mass and to be competitive, without ignoring a certain need for maintaining a local influence. This fact justifies the need to develop professional skills that protect human beings from the vulnerability to which they are subjected in the new forms of production. The danger resides not only in their relation with others but in their current jobs, particularly as they are a point in a complex network that presents continuous demands to which a response has to be given. For all these reasons, teachers who live in contemporary, technologically developed

societies need to be taught well. That is, among its many aspects, technological literacy must include basic knowledge on economic-labour, political and cultural dimensions of the development of new computer products.

4. Final reflections

Having justified the diverse groups of contents that are to be included in a teacher training curriculum, there is now only enough room left for some final considerations. One of these is the ease with which these subject matters permit us to analyse how computer and communication technologies are being introduced into schools. In the first place, some authors (Noble, 1998; Apple, 1998) consider this incorporation to be a response to nothing other than the converting of "a company's needs" into the primary objectives of the educational system because, among other aspects, they introduce a language of efficiency, profitability, and a determined way of technocratic thinking. In the second place, such an incorporation cannot be thought of as a demand for qualified labourers in new technologies because, in reality, these current technological products, belonging to business administration and management, are being used to eliminate jobs and reduce expenses, dividing jobs into small routine tasks and making it easier to watch over workers, control them and govern their actions.

These ideas can be checked when we analyse how neo-liberal administrations of educational institutions propose the incorporation of NTs in schools. It is intersting that these are being introduced without the existence of any previous public debate in which teachers participate or where they can manifest the need for solid professional training in order to be active participants—self-sufficient and creative—both in the use of these tools and in the elaboration of their own materials. These materials will contribute as much to knowing and understanding their immediate surroundings as to exposing possible problems (inequalities between students, irrationality in the use of "extracurricular time", etc.). If it were not so, schools would depend on software designed, published and distributed by businesses, initiating a process of educational industrialization which would delight the publishing market. In this case, the incorporation of new technologies in schools would emphasize applying to teaching control and bureaucratisation procedures that mirror what has occurred in the labour world.

Finally, I want to sum up by affirming that the main reason for writing this article was none other than to propose the principal topics for the subjects "Educational Technology" and "New Technologies Applied to Education". The justification for this thematic grouping can be found in the two focuses, both the technological and the practical or situational, that orient technological innovation, change and application. These are two conceptions of development that respond to different problems and interests and that, inevitably, will produce distinct dilemmas. It is possible, however, to approach both ideas by making new computer and communication technologies "express themselves", and they will "express themselves" when we manage to diminish their informal use by following newly revised official recommendations, by questioning the rules and theories that support their application, and by analysing the elements and the relations that have guided their development. And when these current technologies finally "speak", "they will say" what they can and cannot do, in this way revealing the elements they have given priority to throughout their history, so that we can rediscover their implications and readopt the roles that control their workings in the various fields

where they are applied (industrial, educational, etc.). This is a proposal of subject matters, then, directed towards sensitising, compensating, reflecting and investigating what technologies do and do not do in the genesis of inequalities and other human miseries. That is to say, these are contents that attempt to thoroughly examine and to make patent the goals set forth by King Juan Carlos I of Spain during the opening ceremonies of the Tenth World Congress of Computer Technologies.

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